Calhoun: The NPS Institutional Archive
DSpace Repository

Theses and Dissertations 1. Thesis and Dissertation Collection, all items

1987

An evaluation of the manpower staffing system for the Naval Facilities Engineering Command's facilities acquisition mission.

Rado, Kenneth L.

http://hdl.handle.net/10945/22786

Downloaded from NPS Archive: Calhoun

Calhoun is the Naval Postgraduate School's public access digital repository for research materials and institutional publications created by the NPS community. Calhoun is named for Professor of Mathematics Guy K. Calhoun, NPS's first appointed -- and published -- scholarly author.

Dudley Knox Library / Naval Postgraduate School
411 Dyer Road / 1 University Circle
Monterey, California USA 93943

http://www.nps.edu/library

DUDLEY KNOX LIBRARY
NAVAL POSTGRADUATE SCHOOL
MONTEREY, CALIFORNIA 93943-5002

NAVAL POSTGRADUATE SCHOOL

Monterey, California

THESIS

AN EVALUATION OF THE MANPOWER STAFFING SYSTEM FOR THE NAVAL FACILITIES ENGINEERING COMMAND'S FACILITIES ACQUISITION MISSION

by

Kenneth L. Rado

March 1987

Thesis Advisor: R. A. Weitzman

Approved for public release; distribution is unlimited

T233635

REPORT DOCUMENTATION PAGE

1a REPORT SECURITY CLASSIFICATION
UNCLASSIFIED

1b RESTRICTIVE MARKINGS

2a SECURITY CLASSIFICATION AUTHORITY

2b DECLASSIFICATION / DOWNGRADING SCHEDULE

3 DISTRIBUTION / AVAILABILITY OF REPORT
Approved for public release;
distribution is unlimited

4 PERFORMING ORGANIZATION REPORT NUMBER(S)

5 MONITORING ORGANIZATION REPORT NUMBER(S)

6a NAME OF PERFORMING ORGANIZATION
Naval Postgraduate School

6b OFFICE SYMBOL (If applicable)
54

7a NAME OF MONITORING ORGANIZATION
Naval Postgraduate School

6c ADDRESS (City, State, and ZIP Code)
Monterey, California 93943-5000

7b ADDRESS (City, State, and ZIP Code)
Monterey, California 93943-5000

8a NAME OF FUNDING / SPONSORING ORGANIZATION

8b OFFICE SYMBOL (If applicable)

9 PROCUREMENT INSTRUMENT IDENTIFICATION NUMBER

8c ADDRESS (City, State, and ZIP Code)

10 SOURCE OF FUNDING NUMBERS

PROGRAM ELEMENT NO	PROJECT NO	TASK NO	WORK UNIT ACCESSION NO

11 TITLE (Include Security Classification)
AN EVALUATION OF THE MANPOWER STAFFING SYSTEM FOR THE NAVAL FACILITIES ENGINEERING COMMAND'S FACILITIES ACQUISITION MISSION

12 PERSONAL AUTHOR(S)
Rado, Kenneth L.

13a TYPE OF REPORT
Master's Thesis

13b TIME COVERED
FROM ________ TO ______

14 DATE OF REPORT (Year, Month, Day)
1987 March

15 PAGE COUNT
118

16 SUPPLEMENTARY NOTATION

17 COSATI CODES

FIELD	GROUP	SUB-GROUP

18 SUBJECT TERMS (Continue on reverse if necessary and identify by block number)
Manpower staffing, Manpower forecasting, Naval Facilities Engineering Command, SHORSTAMPS

19 ABSTRACT (Continue on reverse if necessary and identify by block number)

This thesis describes and evaluates the manpower demand forecasting system used by the Naval Facilities Engineering Command (NAVFAC) both to obtain manpower resources for its facilities acquisition mission during the Planning, Programming and Budgeting process and to allocate these resources among its Engineering Field Divisions (EFDs). The method by which NAVFAC developed its manpower demand forecasting is assessed as being valid. This thesis shows that the accuracy of this model, developed in 1980 using FY 79 data, can be enhanced by using more recent data over a period of several fiscal years. This is done in this thesis using FY 85 and FY 86 data. Thesis research showed that this same model can be used as a baseline with a high degree of accuracy to allocate resources among the EFDs; however, an expanded data base is

20 DISTRIBUTION / AVAILABILITY OF ABSTRACT
☒ UNCLASSIFIED/UNLIMITED ☐ SAME AS RPT ☐ DTIC USERS

21 ABSTRACT SECURITY CLASSIFICATION
unclassified

22a NAME OF RESPONSIBLE INDIVIDUAL
Ronald A. Weitzman

22b TELEPHONE (Include Area Code)
(408) 646-2694

22c OFFICE SYMBOL
54Wz

19. ABSTRACT (Continued)

crucial to improved accuracy. Other manpower staffing factors, not quantified in NAVFAC's staffing model, are described and their effects on staffing requirements appraised. The means by which EFDs internally allocate these resources among Divisions is evaluated, and recommendations for improvements are made.

Approved for public release; distribution is unlimited.

An Evaluation of the Manpower Staffing System for the Naval Facilities Engineering Command's Facilities Acquisition Mission

by

Kenneth L. Rado
Lieutenant, Civil Engineer Corps, United States Navy
B.S.C.E., University of Delaware, 1978

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
March 1987

ABSTRACT

This thesis describes and evaluates the manpower demand forecasting system used by the Naval Facilities Engineering Command (NAVFAC) both to obtain manpower resources for its facilities acquisition mission during the Planning, Programming and Budgeting process and to allocate these resources among its Engineering Field Divisions (EFDs). The method by which NAVFAC developed its manpower demand forecasting is assessed as being valid. This thesis shows that the accuracy of this model, developed in 1980 using FY 79 data, can be enhanced by using more recent data over a period of several fiscal years. This is done in this thesis using FY 85 and FY 86 data. Thesis research showed that this same model can be used as a baseline with a high degree of accuracy to allocate resources among the EFDs; however, an expanded data base is crucial to improved accuracy. Other manpower staffing factors, not quantified in NAVFAC's staffing model, are described and their effects on staffing requirements appraised. The means by which EFDs internally allocate these resources among Divisions is evaluated, and recommendations for improvements are made.

TABLE OF CONTENTS

I. INTRODUCTION . . . 10
  A. SCOPE OF THESIS . . . 11
  B. THE PROBLEM . . . 15
  C. THE GOAL . . . 17
  D. METHODS OF ACHIEVEMENT . . . 17
  E. OVERVIEW OF RESEARCH RESULTS . . . 19
  F. THESIS ORGANIZATION . . . 20

II. BACKGROUND . . . 22
  A. MISSION OF THE NAVAL FACILITIES ENGINEERING COMMAND . . . 23
    1. Naval Facilities Engineering Command Field Activities . . . 24
    2. NAVFAC Headquarters: Organization and Management Process . . . 28
    3. Command Operating Plan . . . 28
  B. EFD ORGANIZATION/FUNCTIONAL STATEMENTS . . . 30
    1. NAVFAC Contracting Authority . . . 32
    2. EFDs' Contracting Authority . . . 33
    3. Officer in Charge of Construction . . . 33
    4. Resident Officer in Charge of Construction . . . 36
    5. Construction Division Headquarters Staff . . . 36
    6. Differences in CONUS and OCONUS EFD Organizations for . . . 37
    7. Differences in EFD Acquisition Organizations . . . 37
    8. Complexities of "Universal" Divisional Budgeting Methods . . . 41
    9. Program Concept Facilitates Manpower Budgeting . . . 41
  C. THE FACILITIES ACQUISITION PROCESS/MANPOWER BUDGETING PROCESS . . . 42
    1. Facilities Acquisition . . . 42
    2. Manpower Acquisition Process . . . 49

3. Effects of the Acquisition Process on Manpower Staffing 50

D. FURTHER COMPLEXITIES 54

1. EFD Division Level 54

2. ROICC/Project Level 72

E. SUMMARY 73

III. METHODOLOGY OF DEMAND FORECASTING 74

A. INTRODUCTION 74

1. Criteria for a Good Manpower Forecast 75

2. Chapter Organization 76

B. MANPOWER PLANNING IN THE NAVY 76

C. NAVFAC LEVEL 77

1. Limitations 79

D. VALUE OF STATISTICAL ANALYSIS 80

E. EFD LEVEL 81

F. DIVISION LEVEL FORECASTING 81

G. WORK MEASUREMENT AND THE MOST-EFFICIENT-ORGANIZATION CONCEPT 82

1. Developing the Manpower Standard 85

2. Section Summary 87

H. CHAPTER SUMMARY 88

IV. EVALUATION OF NAVFAC'S CURRENT MANPOWER STAFFING SYSTEM 89

A. DEVELOPMENT HISTORY OF NAVFAC MANPOWER FORECASTING SYSTEM 89

B. METHODOLOGY 96

1. Development of Staffing Standard Equation 98

2. Assumptions 103

C. INTERPRETATION OF DATA 103

1. The Need for Updated Weighted WIP Factors 105

D. RESOURCE ALLOCATION TO THE EFDS 105

1. Validity of SHORSTAMPS Model in Staffing EFDs 107

2. Influences of "Complexities" on EFD Staffing 109

E. ALLOCATING RESOURCES AMONG DIVISIONS 110

F. CHAPTER SUMMARY 112

V. CONCLUSIONS, RECOMMENDATIONS AND AREAS OF FURTHER STUDY 113

LIST OF REFERENCES 115

INITIAL DISTRIBUTION LIST 117

LIST OF TABLES

1. FY 85 PROGRAM IV WORK-YEARS AND WORK-IN-PLACE DATA 16
2. DISTRIBUTION OF EFD ACQUISITION ORGANIZATION RESOURCES, FY 86 32
3. NORTHDIV ROICC WIP CATEGORIES 56
4. SOUTHDIV ROICC WIP CATEGORIES 57
5. WESTDIV ROICC WIP CATEGORIES 58
6. CHESDIV ROICC WIP CATEGORIES 59
7. DESIGN-IN-PLACE AND 04 WORK-YEAR DATA 65
8. WORK-IN-PLACE AND EFD WORK-YEAR DATA 65
9. DESIGN-IN-PLACE AND CHANGE ORDER DATA 69
10. CONTRACT AWARDS BY FUND SOURCE, FY 86 92
11. CONTRACT PARAMETERS FY 85 & FY 86, CONUS EFDS 98
12. FY 85/86 EFD WIP BY FUND SOURCE (CONSTANT FY 79 $, MIL) 99
13. DEVELOPMENT OF UPDATED WEIGHTED WIP COEFFICIENTS 100
14. FY 85/86 CONUS EFD WEIGHTED WIP BY FUND SOURCE 101
15. COMPARISON WITH NAVFAC WIP FACTORS 102
16. EFD PROGRAMS IX & IV LABOR COST COMPARISON 102
17. PERCENTAGE WIP BY FUND SOURCE 104
18. PERCENTAGE WIP BY FUND SOURCE BY EFD 108
19. REDISTRIBUTED LABOR HOURS BASED ON NEW STAFFING EQUATION 109

LIST OF FIGURES

1.1 NAVFAC Organization 13

1.2 EFD Organization 13

2.1 NAVFAC Field Activities 26

2.2 EFD Geographical Responsibilities 27

2.3 Code 02--SOUTHDIV 34

2.4 Code 04--LANTDIV 34

2.5 ROICC Organization--SOUTHDIV 38

2.6 NORTHDIV Pilot Organization 39

2.7 NORTHDIV's Facilities Engineering Department 39

2.8 PPBS Process 44

2.9 MILCON Process 48

2.10 MILCON Stability 52

2.11 Work-In-Place 55

2.12 Contracts Awarded (EFD) 60

2.13 Contracts Awarded (EFD/OICC) 60

2.14 Design-In-Place 61

2.15 Work-Year to WIP 62

4.1 NAVFAC Cost Account Codes 97

I. INTRODUCTION

How many people will we need? This is one of the most perplexing questions faced by a manager, or an organization, because it is so difficult to answer and so much is at stake. For the Naval Facilities Engineering Command (NAVFAC) and its six subordinate Engineering Field Divisions (EFDs), which are charged with designing and administering more than $6 billion in construction work per year, as well as managing and maintaining nearly five million acres of Navy and Marine Corps real estate with a facilities inventory worth more than $100 billion,[1] this is a particularly vital question. Consider that most managers have difficulty determining personnel needs for their own departments, magnify this by at least four major departments in an EFD, each department with staffs ranging from 50-400 people, project this through the six EFDs of NAVFAC, add a dozen or so staffing "factors" to complicate matters, and it is seen why manpower planning/staffing is one of the most important and complex tasks confronting NAVFAC management.

With overstaffing, costs are excessive, people are not fully utilized, and productivity suffers. And when government organizations operate under austerely limited personnel ceilings, overstaffing in one department or organization means that fewer personnel resources are available to other departments/organizations. Understaffing leads to consequences just as bad, according to a study done for the Army Corps of Engineers by the Logistics Management Institute:

> It is apparent from historical information that greater design and construction workload is being performed than in the past and with fewer manpower resources. The historic USACE (U.S. Army Corps of Engineers) level of resource requirements for providing design and construction services is comparable to that of other public and private sector design and construction agents. Our previous studies on DoD construction and management costs lead us to believe that increasing the ratio of workload to manpower has resulted in increased costs in terms of customer dissatisfaction, failure of the facility to meet the need for which it was built, and increased change orders. [Ref. 1: p. 4]

It is apparent that understaffing leads to missed opportunities. Because of hiring and other personnel-action constraints, an EFD's work force cannot be added to or cut on short notice, or in some instances at all, without incurring substantial costs, in terms of both money and productivity. Thus, manpower planning staffing is one of the keys to holding down personnel costs and stimulating productivity. With so much at stake one would think that, given the level of sophistication in management science, manpower staffing would be as exact a process as, say, forecasting the weather. Of course, forecasting the weather is *not* an *exact* science. Richard Fantzreb sums it up:

---

[1] Source: NAVFAC Code 05

> But why has there been so little success in making human resource planning work? Primarily because it has proved to be quite difficult to forecast an organization's need for people. Is this a surprising statement? How many organizations can say with confidence whether they are overstaffed, understaffed, or properly staffed at a given moment in time? [Ref. 2: p. 859]

This thesis takes a practical look at the subject of manpower requirements forecasting. It explores the logic of the process, reviews the techniques, surveys some of the obstacles encountered in practice, points the way to sources of further information for the EFDs, and makes recommendations for improvements to current methods employed.

A. SCOPE OF THESIS

Although this research is primarily of interest to senior managers in the NAVFAC organization, the research analyses, recommendations, and conclusions can easily be adapted by the manager of any organization who is interested in determining manpower requirements. This thesis thus includes brief explanations of NAVFAC's organization and programs to aid the understanding of the uninitiated.

This thesis addresses the topic of "demand forecasting," which essentially answers the question: "How many people do we need?" Not addressed is a related question in personnel resource management: "How many people will we need to hire (or train)?" This latter aspect involves developing a detailed summary of each employee's skills and training background, construction of ***Replacement Charts*** which detail who will replace whom in the event of a job opening, and development of ***Replacement Summaries*** which supplement Replacement Charts and list likely replacements and their relative strengths and weaknesses for each job [Ref. 3: p. 120]. Investigating the hiring and training system at NAVFAC was considered beyond the scope of this thesis.

The first question, "How many people do we need?", for the EFDs, is determined by future workload, technology, productivity, contracting regulations, and a variety of other factors.

The second question can be approached only after the first is answered, and only after it has been determined how may present employees will be available at some future time to meet staffing needs. Finding out how many employees will be available in various skill categories after allowing for turnover, retirement, promotion, etc., is often called "supply forecasting." Determining the total number of employees required is then called "demand forecasting." The first question is answered by a demand forecast. The second question is answered by subtracting the supply forecast from the demand forecast. [Ref. 2: p. 850]

The scope of this thesis is also narrowed to studying demand forecasting and resource allocations for NAVFAC's EFD Facility Acquisition Mission,[2] which is embodied in Program IV and the Facility Support Contracting portion of Program IX, which together comprise approximately 65% of EFD staffing. Program IX staffing in this thesis refers only to Code 02 (Contracts) and Code 05 (Construction). The following is a brief explanation of NAVFAC's management by Programs, taken from the fiscal year 1986 NAVFAC Operating Plan:

> One of the basic precepts of the Command is that we staff through an organizational structure and we execute our mission and resources through a program structure. The organizations at Headquarters and the various field activities are broken down into work centers (departments, divisions, branches, sections, etc.), through which we gather together staffs of specific expertise and provide for personnel management. Through a properly staffed organizational structure, we attempt to have available the trained work force, in the types of field activities and in the required geographical areas, to provide the various products and services of our Command mission. [Ref. 4: p. 12]

Figures 1.1 and 1.2 depict the NAVFAC HQ organization and a "typical" EFD organization. EFDs carry out their mission in terms of seven Programs [Ref. 4: pp. 21-47]:

- Program II-- Planning and Real Estate. Formulates plans for land and facilities, acquires, leases and disposes of real property, and manages natural resources.
- Program III - Engineering and Design. Manages the design of facilities, applies high technology to improve design quality and productivity, develops design and construction criteria, and provides engineering consultation.
- Program IV - Construction. Manages world-wide construction of facilities for the Navy, Marine Corps, and other U.S. government organizations.
- Program VI - Seabees. Supports the active and reserve Naval Construction Force.

---

[2] In NAVFAC jargon, facilities acquisition is synonymous with construction.

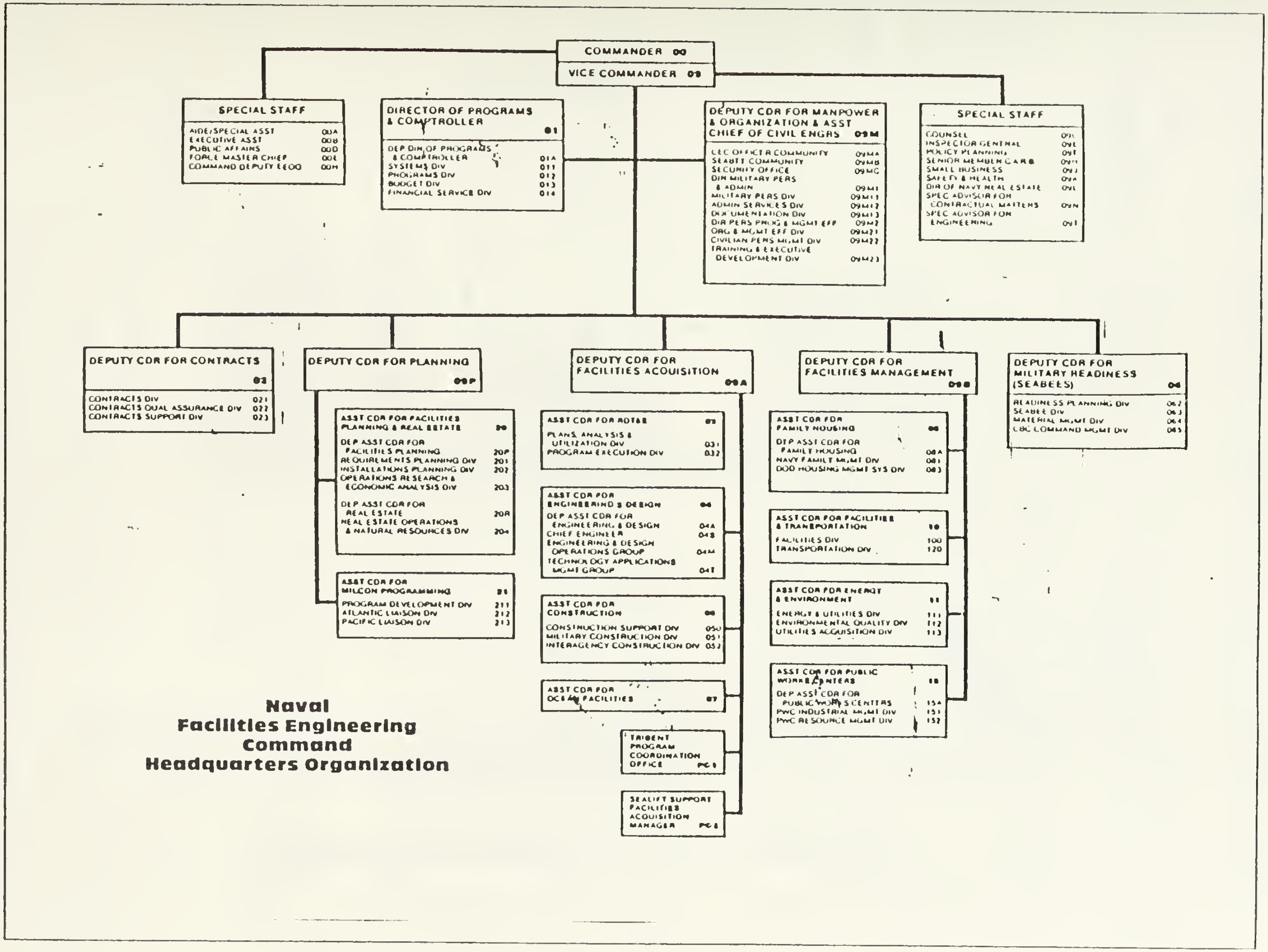
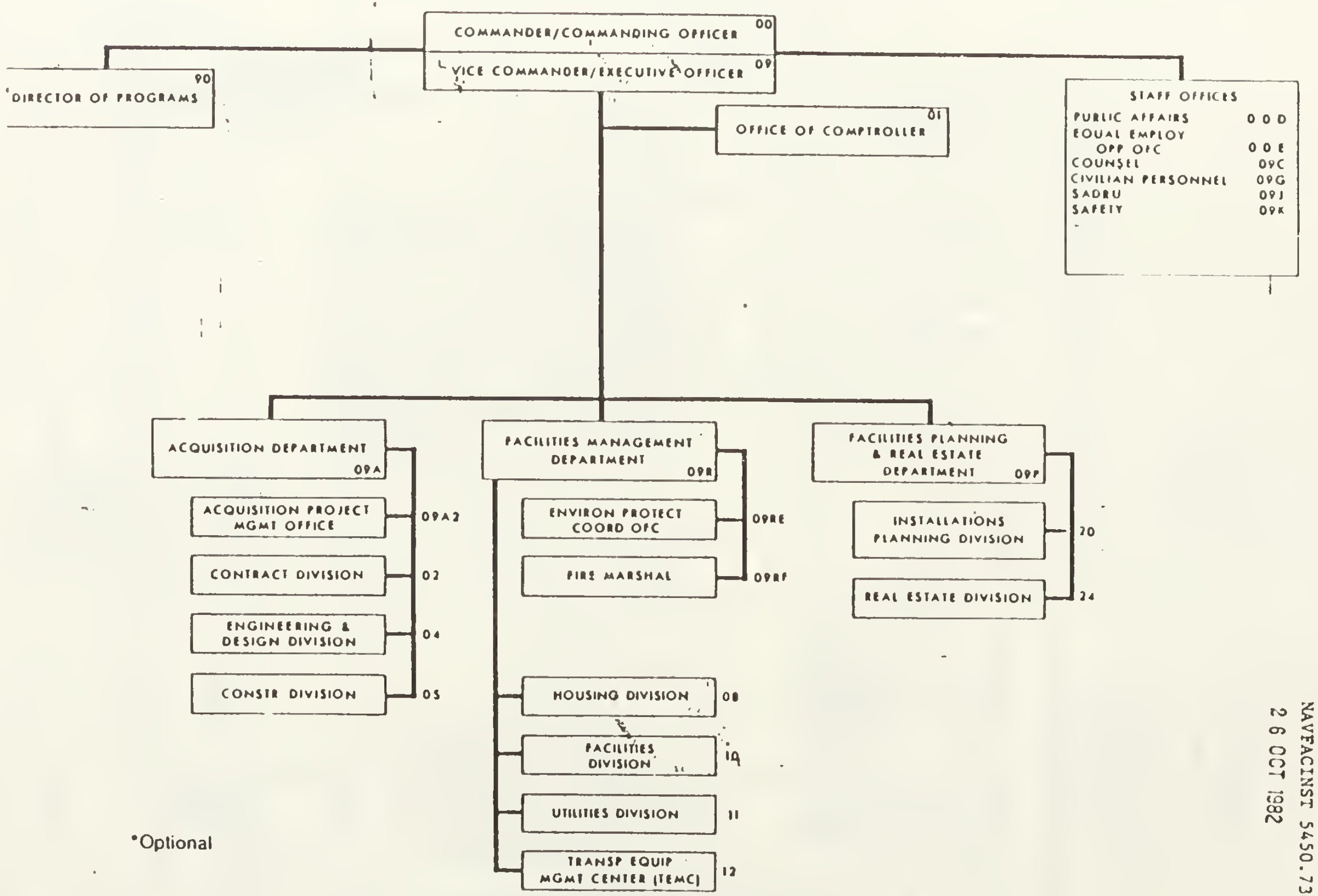

COMMANDER 00
VICE COMMANDER 09
SPECIAL STAFF
AIDE/SPECIAL ASST 00A
EXECUTIVE ASST 00B
PUBLIC AFFAIRS 00D
FORCE MASTER CHIEF 00E
COMMAND DEPUTY EEOO 00H
DIRECTOR OF PROGRAMS & COMPTROLLER 01
DEP DIR OF PROGRAMS & COMPTROLLER 01A
SYSTEMS DIV 011
PROGRAMS DIV 012
BUDGET DIV 013
FINANCIAL SERVICE DIV 014
DEPUTY CDR FOR MANPOWER & ORGANIZATION & ASST CHIEF OF CIVIL ENGRS 09M
CEC OFFICER COMMUNITY 09MA
SEABEE COMMUNITY 09MB
SECURITY OFFICE 09MC
DIR MILITARY PERS & ADMIN 09M1
MILITARY PERS DIV 09M11
ADMIN SERVICES DIV 09M12
DOCUMENTATION DIV 09M13
DIR PERS PROG & MGMT EFF 09M2
ORG & MGMT EFF DIV 09M21
CIVILIAN PERS MGMT DIV 09M22
TRAINING & EXECUTIVE DEVELOPMENT DIV 09M23
SPECIAL STAFF
COUNSEL 09C
INSPECTOR GENERAL 09G
POLICY PLANNING 09F
SENIOR MEMBER CAB 09H
SMALL BUSINESS 09J
SAFETY & HEALTH 09K
DIR OF NAVY REAL ESTATE 09L
SPEC ADVISOR FOR CONTRACTUAL MATTERS 09N
SPEC ADVISOR FOR ENGINEERING 09T
DEPUTY CDR FOR CONTRACTS 02
CONTRACTS DIV 021
CONTRACTS QUAL ASSURANCE DIV 022
CONTRACTS SUPPORT DIV 023
DEPUTY CDR FOR PLANNING 09P
ASST CDR FOR FACILITIES PLANNING & REAL ESTATE 20
DEP ASST CDR FOR FACILITIES PLANNING 20P
REQUIREMENTS PLANNING DIV 201
INSTALLATIONS PLANNING DIV 202
OPERATIONS RESEARCH & ECONOMIC ANALYSIS DIV 203
DEP ASST CDR FOR REAL ESTATE 20R
REAL ESTATE OPERATIONS & NATURAL RESOURCES DIV 204
ASST CDR FOR MILCON PROGRAMMING 21
PROGRAM DEVELOPMENT DIV 211
ATLANTIC LIAISON DIV 212
PACIFIC LIAISON DIV 213
DEPUTY CDR FOR FACILITIES ACQUISITION 09A
ASST CDR FOR RDT&E 03
PLANS, ANALYSIS & UTILIZATION DIV 031
PROGRAM EXECUTION DIV 032
ASST CDR FOR ENGINEERING & DESIGN 04
DEP ASST CDR FOR ENGINEERING & DESIGN 04A
CHIEF ENGINEER 04B
ENGINEERING & DESIGN OPERATIONS GROUP 04M
TECHNOLOGY APPLICATIONS MGMT GROUP 04T
ASST CDR FOR CONSTRUCTION 05
CONSTRUCTION SUPPORT DIV 050
MILITARY CONSTRUCTION DIV 051
INTERAGENCY CONSTRUCTION DIV 052
ASST CDR FOR OCEAN FACILITIES 07
TRIDENT PROGRAM COORDINATION OFFICE PC1
SEALIFT SUPPORT FACILITIES ACQUISITION MANAGER PC2
DEPUTY CDR FOR FACILITIES MANAGEMENT 09B
ASST CDR FOR FAMILY HOUSING 08
DEP ASST CDR FOR FAMILY HOUSING 08A
NAVY FAMILY MGMT DIV 081
DOD HOUSING MGMT SYS DIV 083
ASST CDR FOR FACILITIES & TRANSPORTATION 10
FACILITIES DIV 100
TRANSPORTATION DIV 120
ASST CDR FOR ENERGY & ENVIRONMENT 11
ENERGY & UTILITIES DIV 111
ENVIRONMENTAL QUALITY DIV 112
UTILITIES ACQUISITION DIV 113
ASST CDR FOR PUBLIC WORKS CENTERS 15
DEP ASST CDR FOR PUBLIC WORKS CENTERS 15A
PWC INDUSTRIAL MGMT DIV 151
PWC RESOURCE MGMT DIV 152
DEPUTY CDR FOR MILITARY READINESS (SEABEES) 06
READINESS PLANNING DIV 062
SEABEE DIV 063
MATERIAL MGMT DIV 064
CBC COMMAND MGMT DIV 065
Naval
Facilities Engineering
Command
Headquarters Organization

Figure 1.1 NAVFAC Organization

NAVFACINST 5450.73C
2 6 OCT 1982

STANDARD ENGINEERING FIELD DIVISION ORGANIZATION


COMMANDER/COMMANDING OFFICER 00
VICE COMMANDER/EXECUTIVE OFFICER 09
DIRECTOR OF PROGRAMS 90
OFFICE OF COMPTROLLER 01
STAFF OFFICES
PUBLIC AFFAIRS 00D
EQUAL EMPLOY OPP OFC 00E
COUNSEL 09C
CIVILIAN PERSONNEL 09G
SADRU 09J
SAFETY 09K
ACQUISITION DEPARTMENT 09A
ACQUISITION PROJECT MGMT OFFICE 09A2
CONTRACT DIVISION 02
ENGINEERING & DESIGN DIVISION 04
CONSTR DIVISION 05
FACILITIES MANAGEMENT DEPARTMENT 09R
ENVIRON PROTECT COORD OFC 09RE
FIRE MARSHAL 09RF
HOUSING DIVISION 08
FACILITIES DIVISION 10
UTILITIES DIVISION 11
TRANSP EQUIP MGMT CENTER (TEMC) 12
FACILITIES PLANNING & REAL ESTATE DEPARTMENT 09P
INSTALLATIONS PLANNING DIVISION 20
REAL ESTATE DIVISION 24

*Optional

Figure 1.2 EFD Organization

- Program VIII - Family Housing. Operates and maintains family housing for the Navy.
- Program IX - Facilities Management. Oversees the total Navy public works program.
- Program X - Administration. Provides corporate direction and administrative support for the organization.

It was decided early in the research process to limit the thesis to Programs IV and IX because of the complexity of the manpower budgeting process for the other Programs, as well as the large proportion of an EFD's total staffing comprised by Programs IV and IX. In terms of organizational structure, Programs IV and IX encompass more than 80% of the manpower resources in an EFD's Acquisition Organization consisting of the Acquisition Project Management Office (Code 09A2 or 50), Contract Division (Code 02), Engineering and Design Division (Code 04), Acquisition Support Office (Code 09A1), and Construction Division (Code 05), and a smattering of resources from other Divisions (less than 5% of the resources of the previous five Divisions).

The scope of this research primarily concerns the EFDs with CONUS responsibilities. Because of the wide geographical dispersion of the activities served by the Atlantic and Pacific EFDs and the additional complexity of doing business overseas (or, in some cases, the simplicity of doing business overseas), these two EFDs are organized differently from the EFDs with only CONUS responsibilities. This is not to say that manpower staffing is any less important at Atlantic Division and Pacific Division; however, the operating parameters at these EFDs are slightly different from the others. Statistical comparisons will primarily be directed at the EFDs with CONUS responsibilities.

Lastly, this research deals only with civilian personnel requirements. The requirement for military personnel resources is addressed in an entirely different manner by NAVFAC and is beyond the scope of this thesis.

B. THE PROBLEM

How many people will we need?

For the mission of facilities acquisition the EFDs of NAVFAC have nearly doubled their primary work output of construction dollars work-in-place (WIP) from $1.7B (constant FY 82 $) in FY 76 to a projected $3.2B (constant FY 82 $) in FY 87[3] (the term work-in-place is described further in the paragraphs following). Construction design technology has changed during this ten year period. Contract administration procedures have changed. NAVFAC goals have changed. The organizational structure of the EFDs has changed. In fact, just about everything an EFD does in the way of facility acquisition has changed during this ten-year period (and in the ten years before this), and significantly so.

---

[3] Source: NAVFAC Code 05.

So, how many people do NAVFAC and its EFDs need to do their job?

This thesis was born, in part, out of a desire to answer that question. Research on this topic was actually initiated from a request to explain the statistical anomaly shown in Table 1:

TABLE 1

FY 85 PROGRAM IV WORK-YEARS AND WORK-IN-PLACE DATA

EFD	Work-Years	Work-in-Place ($million)	WY/WIP
Northern Division	465	261	
Southern Division	405	284	
tot	870	545	1.60
Western Division	754	568	1.33

Source: WESTDIV Comptroller

Work-In-Place (WIP), measured in dollars, is the culmination of the facilities acquisition process--the actual construction of a facility--and is the primary output of Programs IV & IX. WIP is defined as that amount of construction work (in dollars) done by a contractor with costs subsequently billed to the Navy. For example, a contractor is building a hospital for the Navy. The contractor has bid S20 million to build the hospital and the Navy has accepted his bid. At the end of the first month (say September, the last month in the fiscal year) the contractor sends a bill to the Navy for S1 million, thus indicating he has completed S1 million worth of work, or 1/20th of the project. The Navy pays him the S1 million, thus indicating agreement that the contractor has performed that amount of work. Thus, the contractor has performed $1 million worth of WIP, and the EFD under whose cognizance the hospital falls adds that $1 million worth of WIP to their fiscal year total.

Work-years are the total labor hours charged to a job or cost account divided by the total number of productive labor hours for a person in a year, 1741. One work-year is equivalent to one person working for one year.

Table 1 reflects that WESTDIV seemingly accomplished more WIP with less people than did NORTHDIV and SOUTHDIV combined. In fact, twenty percent more. The possible interpretations of this discrepancy are numerous. Was WESTDIV 20% more efficient than the other two EFDs? Was WESTDIV getting shortchanged in the manpower budgeting process, simply getting tasked to accomplish more work with fewer resources? And if this was the case, does NAVFAC have a viable manpower budgeting process? This table was presented to the author and the aforementioned questions posed.

C. THE GOAL

This thesis answers these questions, and more. The means by which NAVFAC projects and fulfills its acquisition mission manpower resource requirements from Congress through the POM process is investigated. Also examined and evaluated is how NAVFAC allocates manpower resources to each EFD for the budget year. Taking this process one step further, the methods by which EFDs allocate these resources internally among Acquisition Organization Divisions are assessed, and recommendations for improvements are made.

D. METHODS OF ACHIEVEMENT

At the start of this thesis, I was almost totally unfamiliar with the mission responsibilities and organizational structure of an EFD, and completely without knowledge of the manpower budgeting process. The statistics in Table 1 represented a potential problem in the allocation of manpower resources that needed to be addressed. Research involved a long course of events starting with learning what an EFD does and how it performs its responsibilities. Numerous interviews were conducted with WESTDIV personnel in the Acquisition Department and Office of the Comptroller. Statistics on staffing and work output were gathered.

Interviews were then conducted with personnel at the Navy Manpower Engineering Center, Detachment Treasure Island, and I became familiar with the Navy SHORSTAMPS (Shore Requirements, Standards, and Manpower Planning System). It was here that I was made aware of the SHORSTAMPS staffing model used by NAVFAC.

Research was further fueled by a report prepared by personnel from Public Works Center, San Francisco, stemming from a management assist at WESTDIV. This report observed that Code 05 (Construction Division) at WESTDIV had reviewed other EFD algorithms for determining personnel requirements and had discovered that there was no consistency between EFD and NAVFAC algorithms. It further recommended that WESTDIV request that NAVFAC establish realistic WIP to work-year conversion standards and implement them at all EFDs [Ref. 5: p. 3]. This last item stemmed from a NAVFAC instruction that provides guidance for staffing Resident Officer in Charge of Construction Offices (ROICC), the field offices that administer all Navy shore facility construction contracts. The guidance is based on total WIP and number of contracts per office. The problem with the instruction is that if the EFDs staffed their ROICC offices according to the guidance they would need almost 60% more people for their ROICC offices than they already have, or had been allotted, and ROICC offices comprise nearly 30% of an EFD's total personnel.

A 1976 thesis written by LCDR D. J. Nash, CEC, USN, then a Financial Management student at NPS, recommended:

> A more realistic method of measuring output or activity is needed for for evaluating an Acquisition department's performance and resource needs at NAVFAC level. If future workload to staffing conversion factors can be developed, a more equitable allocation of resources among the Acquisition departments in various EFDs might be possible . . . .
>
> The basis of the following ideas is that a common system of conversion factors to convert future workload to required staffing should be developed to permit an improved system of allocation of resources among EFDs (at least in the Program III and Program IV areas). First, workload to staffing conversion factors could be most helpful to the CAB (Command Advisory Board) as a predictive device for the allocation of resources among the EFDs. Second, a realistic system of conversion factors could aid the EFDs in allocation of their resources among the divisions. Next, the factors could be used as a measure of comparative performance among the EFDs over a given period. Finally, and most important, these conversion factors could be used to construct the budget base for NAVFAC to be used in obtaining resources from higher authorities. This aspect may become more important with the advent of Zero Base Budgeting. [Ref. 6: pp. 116-117]

It seemed that in ten years NAVFAC had made little or no progress in the area of manpower staffing.

A questionnaire was sent to the Acquisition Department heads at each EFD requesting statistical information as well as methods by which manpower requirements are determined. Follow-up telephone interviews were conducted with the 02, 04, and 05 Division Directors at each EFD to gain further insight into the manpower budgeting process. Additionally, the Information Systems Division at WESTDIV ran computer programs from NAVFAC's IPMS and CMS data base systems to extract special data on labor inputs and workload for the EFD Acquisition Organizations. Important conclusions were drawn from analysis of these statistics.

Manpower staffing and forecasting processes at civilian and government organizations with missions similar to NAVFAC were explored. Interviews were conducted with personnel at Bechtel Engineering International in San Francisco and the Army Corps of Engineers Monterey Field Office and District Office in Sacramento.

Funding was then obtained for a two-day trip to NAVFAC HQ in Alexandria, Virginia. In-depth interviews were conducted with personnel who make the final manpower resource allocation decisions to the EFDs and on whose written testimony Congressional action is taken regarding manpower budgeting. It was here that the strengths and weaknesses of NAVFAC's manpower budgeting system became apparent, as well as the limitations of any statistical system that could possibly be used in such a complex environment as that in which the Navy works. It is also where I began to formulate my recommendations for improvements to the current system. I was also extremely fortunate to come across brief excerpts from an Army Corps of Engineers (ACE) 1985 report on development of their own manpower forecasting system. This report led me to the ACE headquarters in Washington, DC, and there I interviewed personnel who had recently concluded development of a headquarters-level manpower forecasting system. I also received a report done under contract to the Army by the Logistics Management Institute entitled, "Forecasting Corps of Engineers Military Construction Manpower Requirements: A Prototype Model." Additionally, throughout this time numerous civilian and government publications on the subject of manpower demand forecasting were reviewed.

E. OVERVIEW OF RESEARCH RESULTS

From a slate blank of knowledge, my research has educated me tremendously. It is my assessment that the methodology that NAVFAC used in developing their SHORSTAMPS staffing standard to forecast manpower requirements for the Facilities Acquisition mission is valid. However, because this staffing model was developed using a limited data base--only FY 79 data--its accuracy is questioned given the changes that have occurred in the means by which NAVFAC carries out its facilities acquisition mission, fluctuations in workload since the model's inception, and changes in the contracting environment. This thesis updates this model using FY 85 and FY 86 data. Although five of eight regression coefficients in this updated model were very similar in value (within 10%) to those developed by NAVFAC, three of the remaining variables had orders of magnitude differences. These differences could potentially cause NAVFAC's manpower forecast to underestimate "true" requirements, given particular changes in workload composition from those that existed in 1979. Other factors, not quantified in the SHORSTAMPS model, also influence resource allocation. This thesis makes observations on these "other" factors and recommends changes to the way some are interpreted. It also introduces additional influences to be considered when NAVFAC allocates Programs IV and IX resources to the EFDs.

The means by which EFDs internally allocate resources among Divisions is described and appraised. Although there are no published methods to be used as guidance by the EFDs, general methods tended to be similar. Some EFDs did have more formal systems than others and it is hoped that, by describing these, ideas may be spawned for improvements.

Much of manpower demand forecasting relies on statistical analysis. As much as possible, to simplify communicating the results of my research, complex calculations and analyses are avoided. Instead, the results of analyses done by other researchers are summarized, referenced, and in some cases revised with more current data. Unless warranted, no attempt was made to validate the conclusions of statistical analyses done by others and used as references in this thesis.

F. THESIS ORGANIZATION

This thesis continues with Chapter II providing background information on NAVFAC and the EFDs, the facility acquisition process, and factors that affect manpower staffing. Chapter III provides an overview of current methods of manpower demand forecasting gleaned from civilian periodicals, the Navy SHORSTAMPS program, and the Air Force Management Engineering Program. In Chapter IV the evolution of NAVFAC's acquisition mission manpower forecasting model is described and its validity evaluated. Similarly with the Army Corps of Engineers' new model, and the two models are compared. Factors not quantified by NAVFAC's model are described, and recommendations made as to their influences. Chapter IV continues by describing information gathered and results of interviews with the EFD Program and Division Directors and assesses EFD internal resource allocation processes. Chapter V presents recommendations and conclusions.

II. BACKGROUND

The Naval Facilities Engineering Command is in a unique business: performing the acquisition, maintenance, and disposal of Naval shore (and ocean) facilities. It does have its counterparts in other areas of government: the Army Corps of Engineers and the General Services Administration; however, there are major structural differences between these organizations and NAVFAC, which preclude one organization from directly adopting another's staffing methods. However, the Army Corps of Engineers does have a Facilities Acquisition organization, and they do go through an acquisition process similar to NAVFAC, so manpower staffing methods for NAVFAC and ACE will be compared for the facilities acquisition mission. In the private sector few, if any companies, perform the same broad mission as NAVFAC. Most companies specialize in facility design, construction, project management, or, a few, in facilities management. Those companies that do perform integrated missions along the line of NAVFAC do so under different "rules." The Government operates under stringent contracting regulations, with less flexibility in recruiting staff, and Government inspection procedures and reporting requirements make comparisons of manpower staffing methods with the private sector exceedingly difficult.

In order to answer the question, "How many people do we need?", for the entire NAVFAC command structure, and for each EFD, the reader must understand the organizational structure and mission of NAVFAC and the EFDs, the facility acquisition process, the manpower acquisition process, and the numerous factors that affect manpower staffing. This chapter describes the aforementioned aspects, presents general trends in work output and staffing, and delves into the complexity of manpower budgeting for an organization as unique as NAVFAC.

It should be noted that literally volumes of literature have been written on the mission and organization of NAVFAC, and the facility acquisition process. This chapter summarizes these topics and highlights those areas that are particularly pertinent in the manpower budgeting process.

This chapter is organized such that after each major section, (1) Mission and Organization of NAVFAC, (2) EFD Organization, and (3) Facilities/Manpower Acquisition Process, influences of that section on manpower staffing are addressed.

This chapter then concludes with a summarization of these influences and introduces further factors in manpower staffing, unique to NAVFAC and each EFD, that must be taken into account when performing manpower budgeting. This chapter provides a lead-in to Chapters III and IV where the means to deal with these factors is addressed.

A. MISSION OF THE NAVAL FACILITIES ENGINEERING COMMAND

NAVFAC's mission can be grouped into four broad categories: facilities and real estate planning, acquisition of new facilities, facilities management (public works), and military readiness.[4] The following is a brief description of these missions:

Facilities Planning involves assisting shore activities in determining their facilities requirements, programming the correction of facility deficiencies, preparation of the Navy's annual military construction budget, master planning, and management of the Navy's nearly five million acres of real estate.

According to the NAVFAC P-68 Contracting Manual, **Acquisition** involves "The acquiring by contract, with appropriated funds, of supplies or services (including construction) by and for the use of the Federal Government through purchase or lease . . . Acquisition begins at the point when agency needs are established and includes the description of requirements to satisfy agency needs, solicitation and selection of sources, award of contracts, contract performance, and contract administration." [Ref. 7: p. 1.2.5] For NAVFAC, Acquisition involves providing architectural and engineering design and construction of the Navy shore facilities, as well as fixed surface and subsurface ocean structures. Acquisition not only refers to new construction, but to maintenance and repair projects as well.

As part of the Congressionally appropriated Military Construction (MILCON) program process, NAVFAC is involved in testifying before the various committees in the House and Senate as they are considering a given year's Military Construction (NAVY) bill. NAVFAC is then charged directly with accomplishing the acquisition of the various projects included in the Navy's part of that year's MILCON bill. Facilities are also acquired by using funds from sources other than MILCON which must proceed through the five-year-long Planning, Programming, and Budgeting process for approval. Projects funded from Operations and Maintenance (O&M) appropriations from Activity and Claimant annual budgets now comprise one-third of NAVFAC's construction efforts, a significant increase over just 10 years ago. NAVFAC also accomplishes acquisition of facilities for other services and government agencies. This thesis addresses manpower staffing for the acquisition mission.

---

[4] The sources for most of this section were interviews with NAVFAC and EFD personnel, and the NAVFAC Organization Manual.

Facilities Management includes providing technical and managerial advice and assistance regarding:

- Facilities minor construction and major repair projects;
- Facilities fire protection engineering and fire fighting;
- Utilities management and operation;
- Management and operation of transportation and weight handling equipment;
- Programming, planning, design, construction, acquisition and disposal of family housing.

Military Readiness is primarily associated with the support of the Naval Construction Force, as well as the planning and R&D necessary to maintain the capability of providing engineering and related logistics support to the Navy's operating forces in the event of armed conflict.

As can be seen, NAVFAC truly has an integrated mission: planning for facilities, acquiring (constructing) them, and then performing facility maintenance and disposal.

One of the factors complicating the allocation of resources by NAVFAC to the EFDs is that three of the CONUS EFDs have portions of the NAVFAC mission assigned as unique taskings. These will be described later in this chapter.

1. Naval Facilities Engineering Command Field Activities

The four categories of NAVFAC's mission are executed through a field organization. The first three elements of the mission, facilities planning, acquisition, and management, are executed by six Engineering Field Divisions (EFDs), each of which is responsible for a specific geographical area. The following excerpt from NAVFAC Instruction 5450.7 briefly elaborates on the mission of the EFDs:

> To accomplish the planning, design, and construction of public works, public utilities, and special facilities . . . to acquire and dispose of real estate . . . to provide technical advice and assistance on the maintenance of facilities . . . to administer the assignment, replacement and disposal of transportation, construction, fire fighting, and weight handling equipment . . . . [Ref. 8: p. 1]

The fourth aspect of NAVFAC's mission, military readiness, is carried out by two Construction Battalion Centers, one located in Port Hueneme, California, and the other in Gulfport, Mississippi. Figure 2.1 shows the major field activities of NAVFAC.

There are six EFDs that serve the U.S. and the Atlantic and Pacific areas:

- Northern Division (NORTHDIV, or ND), located in Philadelphia, administers the northeastern region of the U.S.
- Southern Division (SOUTHDIV, or SD), located in Charleston, administers the southern region of the U.S.
- Chesapeake Division (CHESDIV, CD), located in Washington, D.C., administers the nation's capitol area.
- Western Division (WESTDIV, or WD), located in San Bruno, California, administers the western region of the U.S. and Alaska.
- Pacific Division (PACDIV), located in Pearl Harbor, administers the Pacific region of the world, including Japan, the Philippine Islands, and the Marianas Islands.
- Atlantic Division (LANTDIV), located in Norfolk, administers the Atlantic region of the world, including Europe, the Middle East, Iceland, and Africa.

Figure 2.2 depicts the EFD geographical responsibilities for the Continental United States (CONUS).

Pausing for a moment, I realize that managers at NAVFAC or an EFD may dismiss this section of the thesis as "old hat" and question the relevance of this discourse on manpower staffing. In fact, it is quite relevant. Manpower staffing must not only take into account the volume of the obvious types of work output, but also the demographics of areas served, missions unique to a particular EFD, the numbers and dispersion of activities served, the general capabilities of contractors in a geographical area, the organizational structure of an EFD, and the numerous other factors that contribute to the uniqueness of a particular EFD. If all EFDs were the "same," manpower budgeting at NAVFAC would simply be a matter of relating basic outputs to inputs. The influences of these factors will be discussed throughout this chapter.

NAVFAC facilities management is executed by Public Works Departments (PWDs) located at individual Naval shore activities, or through nine Public Works Centers (PWCs), which are located in areas where there are concentrations of Naval Activities. These PWCs are separate commands and operate like non-profit businesses. The PWDs and PWCs receive technical and management support from the EFD within whose geographical area they are located; however, CONUS PWCs fall under NAVFAC's direct chain of command, and, as such, they receive resources and workload tasking directly from NAVFAC.

To handle a high priority or specialized acquisition project of a large scale, which requires special management attention, NAVFAC establishes a separate Officer

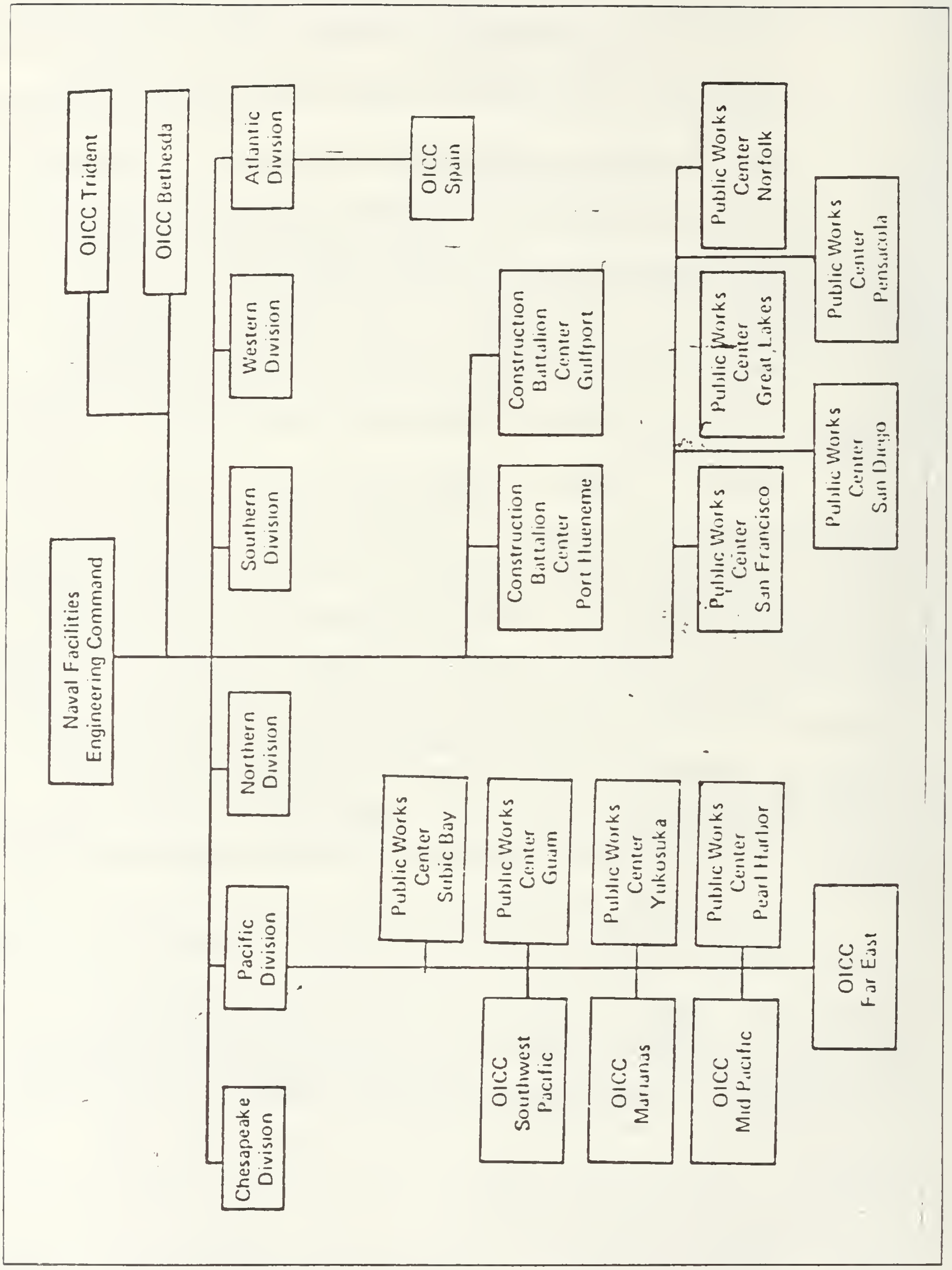

Naval Facilities Engineering Command
OICC Trident
OICC Bethesda
Atlantic Division
OICC Spain
Western Division
Southern Division
Northern Division
Pacific Division
Chesapeake Division
Construction Battalion Center Gulfport
Construction Battalion Center Port Hueneme
Public Works Center Norfolk
Public Works Center Pensacola
Public Works Center Great Lakes
Public Works Center San Diego
Public Works Center San Francisco
Public Works Center Subic Bay
Public Works Center Guam
Public Works Center Yokosuka
Public Works Center Pearl Harbor
OICC Far East
OICC Southwest Pacific
OICC Marianas
OICC Mid Pacific

Figure 2.1 NAVFAC Field Activities

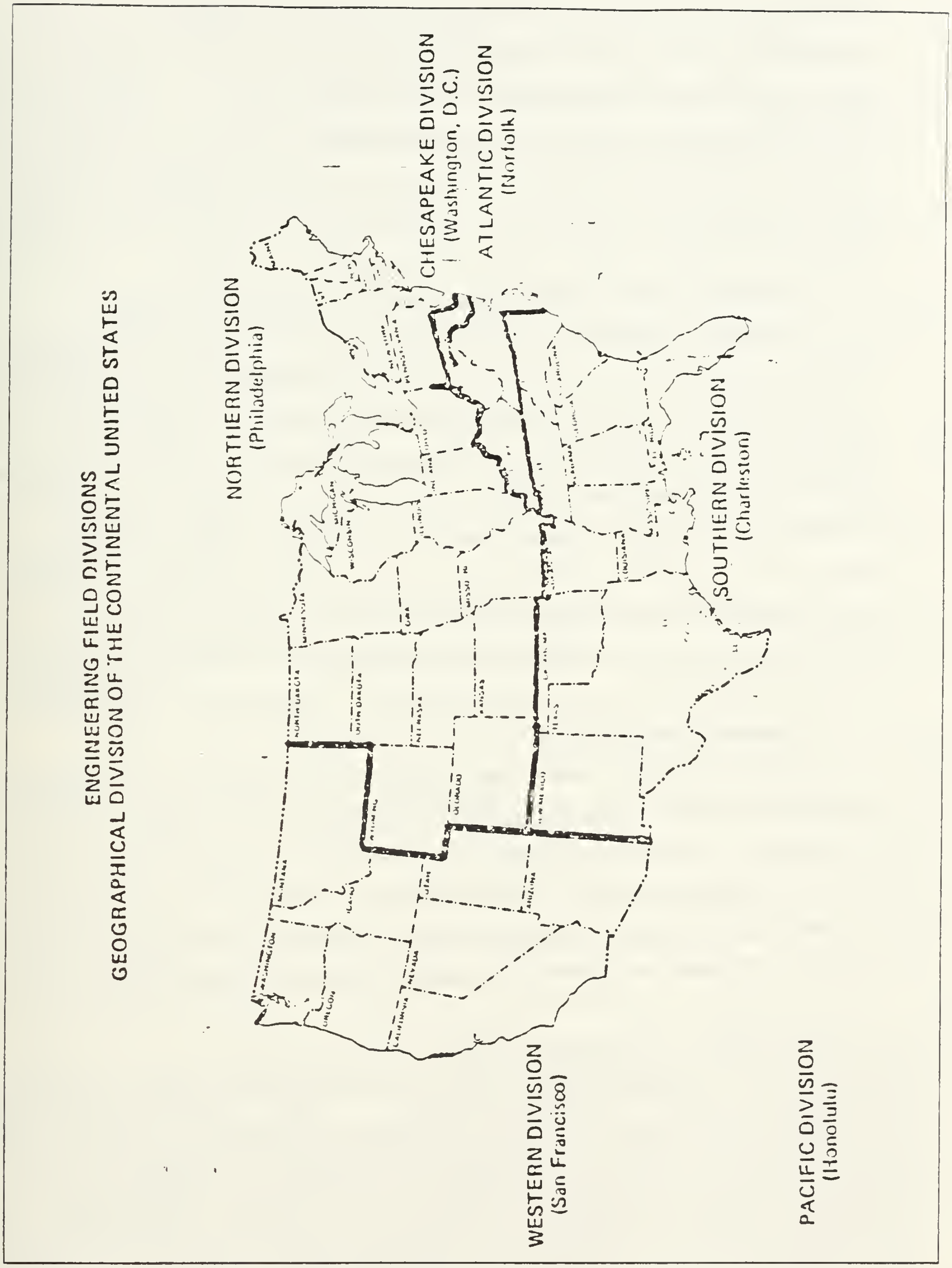


Figure 2.2 EFD Geographical Responsibilities

in Charge of Construction (OICC) organization to oversee the project on a conception-to-completion basis. These organizations report directly to NAVFAC. NAVFAC currently has four such organizations: OICC Trident, which was established to oversee the planning through construction of approximately $1 billion in facilities to support the Trident Submarine program, and three other OICC organizations which are now closing out their construction efforts. These include OICC Diego Garcia, OICC Navy Medical Command, San Diego, and OICC Travis Air Force Base.

2. NAVFAC Headquarters: Organization and Management Process

NAVFAC headquarters is organized along four broad functional mission categories, described earlier. NAVFAC headquarters organization is shown in Figure 1.1. In 1959 NAVFAC adopted the Program concept where it grouped its efforts into a series of product and service areas. This concept has been integrated into a system of Management by Objectives. Today, there are nine Programs that are used by NAVFAC to set priorities, allocate resources, and evaluate performance. Each of these Programs has a Program Manager at NAVFAC who oversees the definition of Program goals and objectives, is involved in projecting and assigning future workload, and is the primary mentor in allocating resources among NAVFAC field organizations and in appraising performance towards meeting the assigned goals and objectives.

3. Command Operating Plan

The key documents that communicate NAVFAC's goals, plans, and allocation of Program resources are the Command Operating Plan (OP-Plan) and Command Guidance (CG). Each is promulgated yearly. The CG provides overall NAVFAC direction, management policy, and general goals, and the OP-Plan provides specific goals and Program resource allocation. These resources are funding dollars and labor work-years.[5] The basis of the OP-Plan, and of NAVFAC's management policy, is the system of Management by Objectives. As stated by RADM J. P. Jones, CEC, USN, Commander NAVFAC, in OP-Plan 86: "I have directed . . . the substance of our annual goals . . . to actions which depict truly significant achievements sought during the fiscal year." [Ref. 4: p. i] For example, the following are excerpts from the FY 86 OP-Plan Program IV goals:

---

[5] As an element of background, formerly Naval activities' people resources were limited by on-board ceiling constraints. Now a Naval activity can have as many people on board at a given time as desired. However, at the end of the fiscal year the work-years expended by that activity's personnel cannot exceed the work-year ceiling. Work-years being defined as labor hours expended divided by the total number of available work hours in a year (1775 productive hours). This form of restriction resulted in the practice of hiring large numbers of temporary personnel at the beginning of a fiscal year and then terminating their employment later in the year to meet work-year ceiling constraints. A loophole in manpower staffing that existed until October 1986 was that work-year ceilings did not constrain an activity to the grade structure of its personnel. There was virtually no consideration of the cost of labor. Work-years were allocated along with funds to pay for labor, but if additional O&M funds were available from other sources (like facility maintenance) the activity could use these additional funds to pay for a mix of higher graded GS personnel. As a result, Navy labor costs skyrocketed. SECNAV Lehman closed this loophole when he enacted the "Managing to Payroll" program. Now, activities can no longer use "spare" O&M funds to pay labor costs.

"Major emphasis in FY 86 will be to carry out our mission in an efficient and cost effective manner:

a) Improve NAVFAC contracting practices by conducting procurement Management Review visits . . . and establishing business clearance review section to review large negotiated contracts.

b) Improve timeliness of construction project completion and turnover . . . .

35% Design Completion--Complete all FY 87 MCON projects which have been authorized for design on a timely basis, to the 35% design stage by 30 November.

Work in Place--Achieve FY 86 Income and Non-Income bearing WIP targets as follows . . . " [Ref. 4: p. 46]

The goals cited in the OP-Plan are mandatory and field activities do not have flexibility in dealing with the goals as they do, to some extent, with the resource allocations.

The OP-Plan, being the key document driving the manpower budgeting process, is not developed in a vacuum but is really a contract negotiated between NAVFAC and its field activities. The EFDs "agree" to achieve specific goals and, in turn, NAVFAC provides resources to accomplish these goals. Of course, NAVFAC receives these resources from CNO and Congress. How these resources are obtained is addressed later in this chapter. This process (provision of resources to the EFDs) begins with a tentative allocation of resources through an iterative exchange between the Program Managers at NAVFAC, the EFDs and the Command Advisory Board (CAB), a group of senior NAVFAC managers charged with advising the Commander NAVFAC, and the field activities that will execute the OP-Plan workload. This process culminates in a Tentative Operating Plan (TOP) which is produced sometime after the mid-year budget review and sent to the field (EFD and other NAVFAC field activities) for comment and reclama. Based on this interchange the OP-Plan is then finalized by the CAB, prior to the start of the fiscal year.

a. Importance of OP-Plan Goals in Manpower Budgeting

Of interest in the manpower budgeting process is the relative importance placed on each of the OP-Plan goals by an EFD Commander. For example, if an EFD has been not been meeting its OP-Plan goals for Design-In-Place (DIP),[6] the Commander may choose to redirect manpower resources from another Program, or another Division within Program IV, to the Design Division (The Design Division, which is responsible for DIP, falls under Program IV). This may be done (and is actually done quite frequently) regardless of what any staffing equation dictates. M. J. Mullen, Executive Assistant at the U. S. Army Corps of Engineers Sacramento District Office, described the situation concisely during an interview when he said, "An EFD Commander will more than likely allocate resources among Divisions by asking himself, 'Where can I take the greatest risk?, and where can I get the best marginal return on my labor investment?'" An interesting question in the facilities acquisition process is, "What Division does provide the greatest 'marginal return' on the investment of labor?" The ultimate goal of the acquisition process is a completed facility. To answer this question, the concept of ***acquisition quality*** must be addressed, for quantity of "marginal return" is meaningless without a measure of quality. A Division can churn out an extra 10 contracts or an additional $5 million WIP with the addition of one more work-year of labor. But without an accurate measure of quality, these numbers are meaningless. The concept of quality, and the answer to the question of "marginal return," will be addressed more fully later in this chapter.

B. EFD ORGANIZATION/FUNCTIONAL STATEMENTS

This information in this section comes from interviews with personnel at each of the EFDs and NAVFAC and from reviewing EFD organization manuals.

All EFDs have a Facilities Management and a Facilities Planning Department, each of which handles their respective part of the EFD mission. Of interest in this thesis is the Acquisition Organization which is responsible for the design, construction, and related contract administration for facilities acquisition for all Navy and Marine Corps Commands, as well as Air Force and other non-Navy customers.

---

[6] A note on the term Design-In-Place (DIP). Before a project ever comes under design its total construction cost is estimated using parametric procedures. DIP is measured at any point in time in the design life of a project by estimating the percent completion of design and equating that to its corresponding construction value. For example, if the estimated construction cost of a project was $100 million, and its design was 50% complete, then the value of DIP is $50 million.

The term "Acquisition Department" is purposely avoided although it is depicted in Figure 1.2: the reason is that the standard EFD organization is now being challenged under a pilot program initiated by NORTHDIV. However, the basic entities of an Acquisition Organization are similar across all EFDs.

Acquisition Project Management Office (Code 09A2 or 50) handles the project management function. This office coordinates the work efforts of the Contract, Design, and Construction Divisions and is responsible for execution of all acquisition projects from the feasibility study stage, through design to construction and transfer to sponsors/customers. A comparison of the structural organization of this Division across the EFDs revealed that 09A2 is primarily organized by function, with project managers responsible for particular functional areas such as waterfront projects, airfield projects, etc. This organization is characterized by a large minimum staffing level (compared to the entire Division) which is independent of workload in a broad minimum-to-maximum range.

Acquisition Coordination Office (Code 09A1) coordinates the overall resources program for the Acquisition Department. It is concerned with utilizing monetary allotments and personnel resources to comply with on-going requirements. At some EFDs this office is part of 09A2, while at others it is a separate office.

Contracts Division (Code 02) performs the contractual tasks required in the procurement of facilities. It is responsible for procedures and actions taken in solicitation of bids and proposals, the award of contracts, and change orders. A comparison of the structural organization of this Division across the EFDs showed that 02 is organized virtually the same at each EFD. This Division is functionally organized with branches for construction contracts, facility support contracts, architect-engineer contracts, and an administrative services branch. Because this Division is segmented to a lesser extent than the other Acquisition Organization Divisions, the staffing levels in 02 are much more responsive to absolute workload changes. Figure 2.3 depicts SOUTHDIV's Code 02 organization. The other EFD Codes 02 are similarly organized.

Design Division (Code 04) is responsible for the design, engineering, and estimation of costs of facilities to be constructed. As stated in the NAVFAC P-68: "The Design Division shall primarily be responsible for the adequacy of the plans and specifications. It shall assure that specifications are clear and unambiguous..." Most of NAVFAC's project designs are done under contract by private Architect-Engineering

(A-E) firms. The Design Division oversees this work, ensuring the design conforms with NAVFAC standards and customer requirements. Approximately 15% of MILCON design is accomplished in-house by Design Division personnel. Figure 2.4 depicts LANTDIV's Code 04. The other EFD Codes 04 are similarly organized.

Construction Division (Code 05) provides construction management and surveillance during the construction of facilities. This it accomplishes through a staff at the EFD headquarters and a field staff--the Resident Officer in Charge of Construction (ROICC) and Officer in Charge of Construction (OICC). A brief, but more detailed discussion of the Construction Division is warranted because of the size (typically 1/3 of an EFD's total staff) and responsibilities of this division. [Ref. 9]

Table 2 depicts the general distribution of personnel resources in each CONUS EFD's Acquisition Organization.

TABLE 2

DISTRIBUTION OF EFD ACQUISITION ORGANIZATION RESOURCES, FY 86

	Percentage Distribution			
EFD	05/ROICC	04	02	09A2/50/09A1
ND	56%	20%	15%	9%
CD	56	20	18	6
SD	58	24	8	10
WD	55	22	12	11

Source: NAVFAC IPMS data base

ND - Northern Division
SD - Southern Division
CD - Chesapeake Division
WD - Western Division

1. NAVFAC Contracting Authority

In order to understand how 05 executes its responsibilities, a brief overview of the authority to perform facility procurement is required. This section draws primarily on the NAVFAC P-68 Contracting Manual, as well as my experience in a ROICC office.

Responsibility for Navy procurement is vested, by statute, in the Secretary of the Navy. The Secretary has delegated this responsibility to the Navy Systems Commanders for procurement of supplies and services for their areas of cognizance. The Commander NAVFAC is designated as "Contracting Officer" for the procurement of specific facility and transportation related items. As stated in the P-68:

> Only Contracting Officers are authorized to enter into, modify and/or terminate contracts. They also issue final decisions on contract disputes, chair selection and negotiation boards, and approve actions such as bid irregularity disposition, business clearances, board reports, and ensure compliance with the terms of the contract. [Ref. 7: p. 1.4.1]

2. EFDs' Contracting Authority

The Commander NAVFAC has redelegated to the EFD Commanders Contracting Officer authority. As stated in the P-68 Contracting Manual, this includes authority for the award and administration of the following types of procurement actions (this list is not all inclusive):

- Sealed bid contracts for new construction, repair or alteration.
- Sealed bid purchase contracts for specialized materials and equipment not available through regular supply channels.
- Sealed bid contracts for demolition and removal of buildings and structures.
- The slating, selection and negotiation of Architect-Engineer and Engineering Service contracts. [Ref. 7: p. 1.4.1]

Authority for negotiated construction contracts is delegated on a case-by-case basis.

3. Officer in Charge of Construction

An EFD Commander can redelegate all or part of his contracting authority to field personnel within his EFD's geographical area of responsibility. This authority is called Officer in Charge of Construction (OICC, or OIC) authority. Normally, he will delegate OICC authority to Navy Civil Engineer Corps Officers who are assigned as Public Works Officers of specific activities, primarily for the purpose of executing the design and construction of projects funded at the activity level. These are primarily Real Property Maintenance (RPM) projects or Facility Support Contracts funded from the activity's Operation and Maintenance (O&M) funds, or "Special" projects funded by Major Claimant O&M funds.[7] Facility Support Contracts are NAVFAC contracts

---

[7] O&M funded projects do not receive Congressional approval by individual project as do MILCON projects, and thus avoid the five-year long Planning, Programming, and Budgeting process through which MILCON projects pass to receive

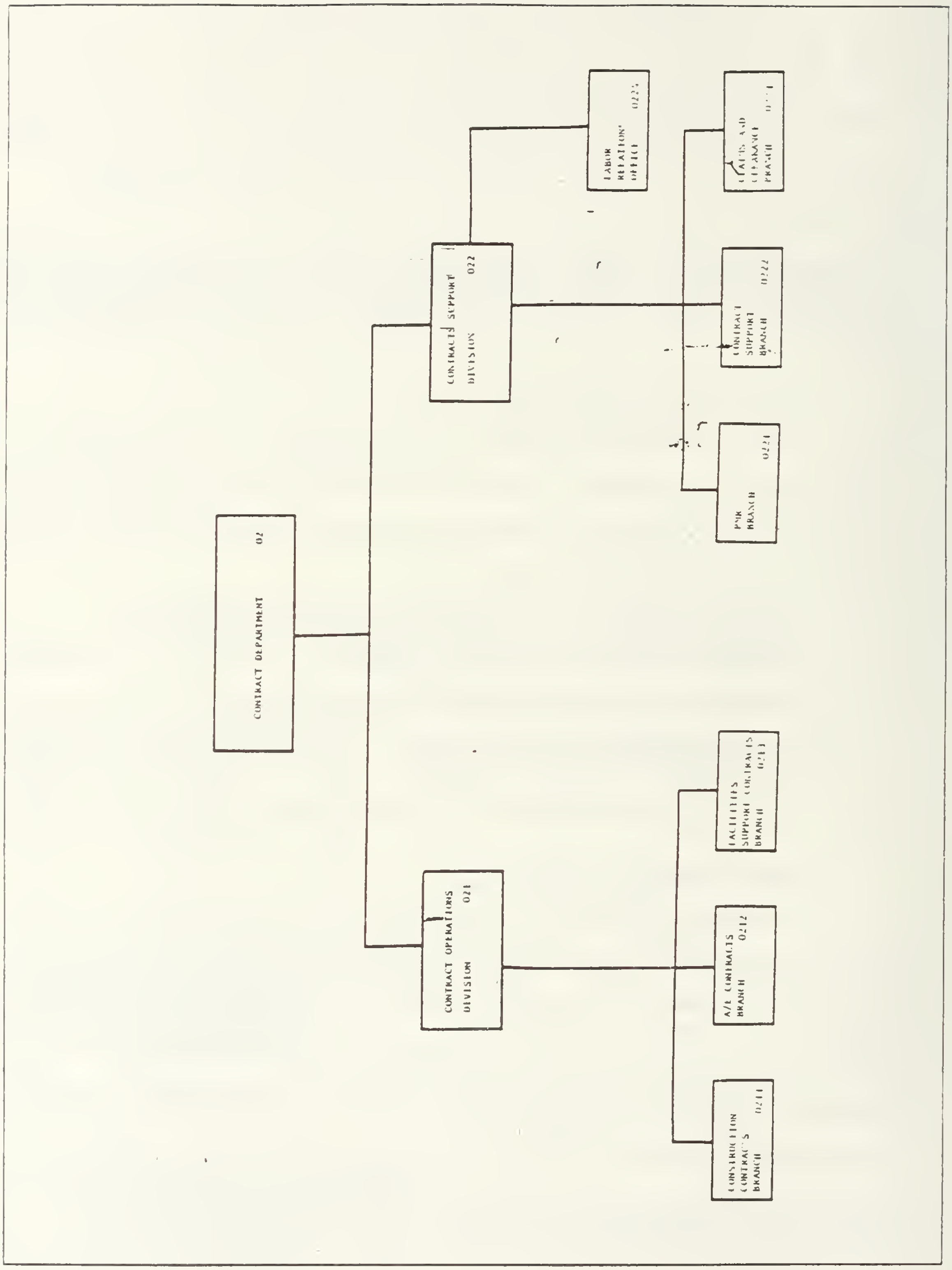

CONTRACT DEPARTMENT 02
CONTRACTS SUPPORT DIVISION 022
CONTRACT OPERATIONS DIVISION 021
LABOR RELATIONS OFFICE 0224
CLAIMS AND CLEARANCE BRANCH
CONTRACT SUPPORT BRANCH 0222
PMR BRANCH 0221
FACILITIES SUPPORT CONTRACTS BRANCH 0213
A/E CONTRACTS BRANCH 0212
CONSTRUCTION CONTRACTS BRANCH 0211

Figure 2.3 Code 02--SOUTHDIV

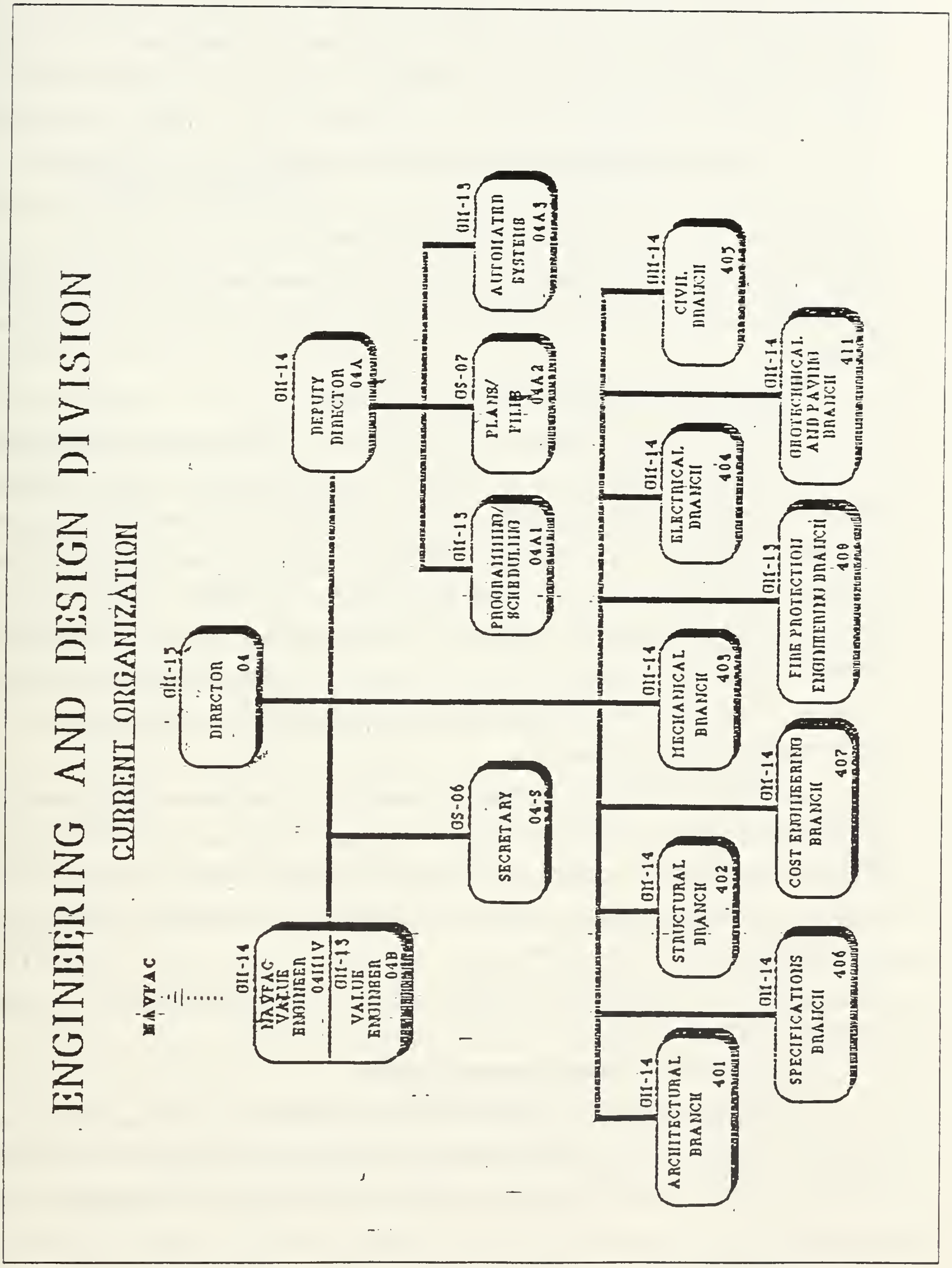

ENGINEERING AND DESIGN DIVISION
CURRENT ORGANIZATION
NAVFAC
GM-14 NAVFAC VALUE ENGINEER 04111V
GM-13 VALUE ENGINEER 04B
GM-15 DIRECTOR 04
GS-06 SECRETARY 04-S
GM-14 DEPUTY DIRECTOR 04A
GM-13 PROGRAMMING/ SCHEDULING 04A1
GS-07 PLANS/ FILES 04A2
GM-13 AUTOMATED SYSTEMS 04A3
GM-14 ARCHITECTURAL BRANCH 401
GM-14 SPECIFICATIONS BRANCH 406
GM-14 STRUCTURAL BRANCH 402
GM-14 COST ENGINEERING BRANCH 407
GM-14 MECHANICAL BRANCH 403
GM-13 FIRE PROTECTION ENGINEERING BRANCH 408
GM-14 ELECTRICAL BRANCH 404
GM-14 GEOTECHNICAL AND PAVING BRANCH 411
GM-14 CIVIL BRANCH 405

Figure 2.4 Code 04--LANTDIV

for public works services such as janitorial services, security services, groundskeeping, utilities maintenance, etc. These contracts now consist of more than 15% of the EFD's WIP efforts (dollar value of Facility Support Contracts are considered WIP), nearly triple the amount of just seven years ago.[8] This growth is largely the result of the Commercial Activities Program, described in Chapter III. This OICC authority covers the entire spectrum of the facilities procurement process: preparation of the plans and specifications for a project, advertising and awarding a construction contract, and the administration of these contracts. This authority is specified in the same language as it is delegated to the EFD, except that dollar limits are imposed for each contract category.

4. Resident Officer in Charge of Construction

The construction contracts for virtually all MILCON projects administered by the four CONUS EFDs are administered through ROICC offices. Additionally, ROICC offices also administer the majority of O&M funded RPM, Facility Support Contracts and "Special" projects. The ROICC office is a field unit of the EFD and has the job of administering construction contracts that an EFD or OICC has awarded. The majority of ROICC offices are co-located with the major Public Works Department or Public Works Center, in a particular area. Most ROICC offices also have OICC authority, and thus a self-contained contracting staff (02 types) may also reside within a ROICC Office.

A note on the term "contract administration:" As defined in the P-68, contract administration is the "process of making payments and assuring that a contractor provides that which is required under a contract which includes monitoring contractor progress, performing quality assurance, and providing or obtaining technical reviews and approvals." [Ref. 7: p. 1.2.8]

Figure 2.5 depicts SOUTHDIV's ROICC organization, which is similar in structure to the other EFDs.

5. Construction Division Headquarters Staff

The 05 headquarters staff provides administrative and overhead support to the OICC/ROICC field offices. Their responsibilites include providing construction policy guidance, developing staffing structures, participating in labor management meetings

---

approval/funding appropriation. However, costs of "new construction" O&M funded projects cannot exceed $200,000.

[8] Source: FACSO reports on EFD WIP.

and negotiations, and administering the construction safety program [Ref. 9: p. 34]. Thesis research included interviewing the 05 Division Directors to find out what staffing methods they used for their field offices. Some were quite innovative and will be described later. In fact, one method could usefully be adapted by other EFD Divisions.

6. Differences in CONUS and OCONUS EFD Organizations for Facilities Acquisition

Earlier it was stated that the scope of this research primarily concerns the EFDs with CONUS responsibilities. Because of the wide geographical dispersion of the activities served by LANTDIV and PACDIV and the differences in doing business overseas, these two EFDs are organized differently than the EFDs with only CONUS responsibilities. PACDIV accomplishes its facilities acquisition responsibilities through five OICC organizations, and LANTDIV carries out all of its acquisition responsibilities in Europe through one OICC. These OICCs carry out the project management, design and construction administration functions for each of the Naval activities within their respective geographical areas, while the EFDs with CONUS responsibilities do most of the design and project management at the EFD. Construction contract administration is performed at various ROICC offices located at or near the construction site.

7. Differences in EFD Acquisition Organizations

Returning now to the discussion on Acquisition organizations, the "typical" EFD Acquisition Department is now undergoing significant changes, initiated by NORTHDIV. In a pilot program, begun in 1985, NORTHDIV changed its organizational structure, moving the Design and Project Management Divisions from the Facilities Acquisition Department (09A) to a newly created Facilities Engineering Department (09X). Figure 1.2 depicts a "typical" EFD and 09A organization. Figures 2.6 and 2.7 present NORTHDIV's EFD pilot organization and their 09X Department. In addition to this structural realignment, there was a functional realignment among Divisions. For example, WESTDIV's Design Division (Code 04) is responsible for the administration of Architect-Engineer contracts, a substantial effort. Under NORTHDIV's functional realignment, this responsibility has shifted to the 05 staff at EFD headquarters. In fact, at each EFD interviewed, certain administrative efforts varied from Division to Division. Thus, the 05 Division at SOUTHDIV did not entirely have the same responsibilities as the 05 at WESTDIV or at CHESDIV.

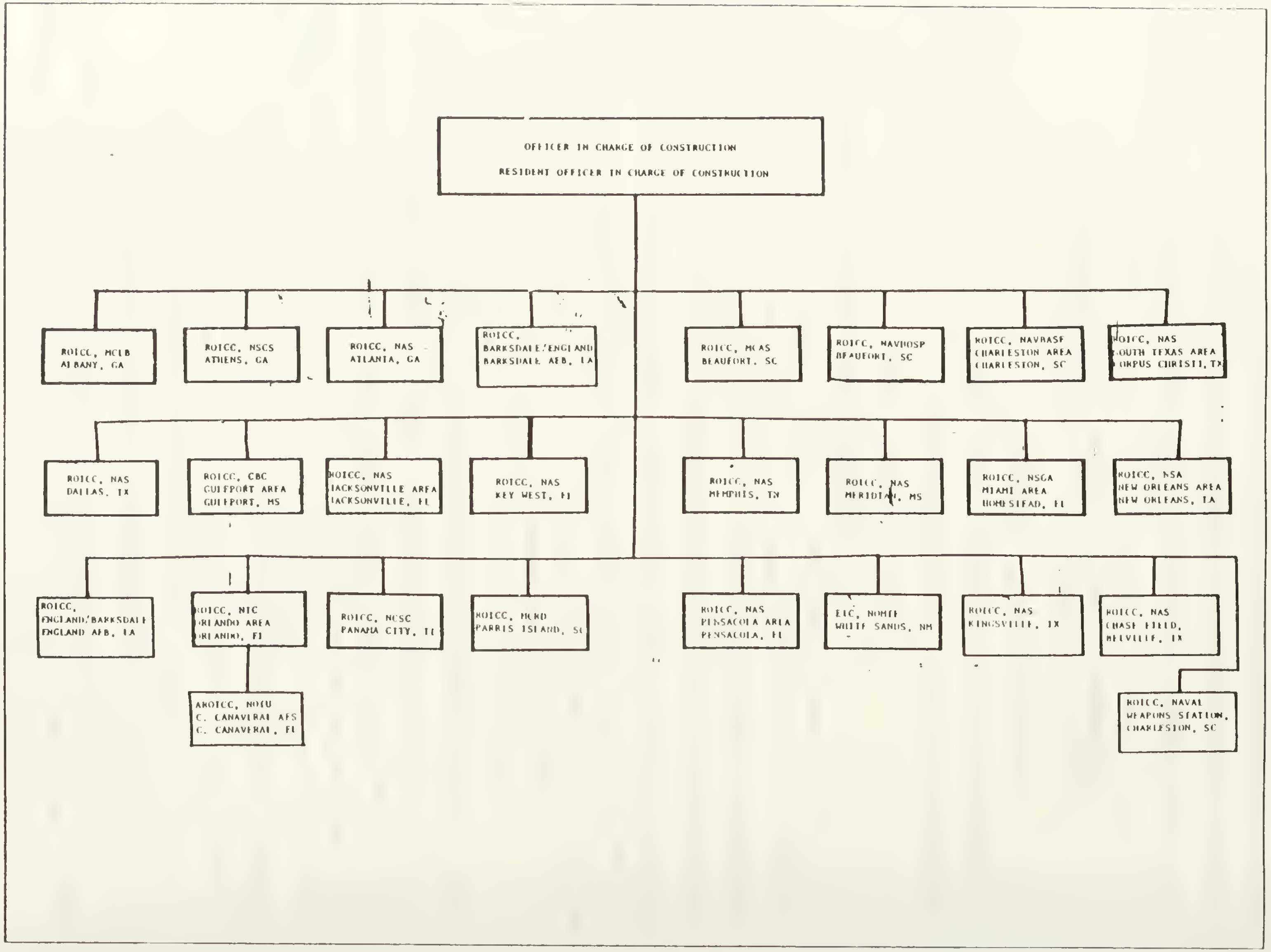

OFFICER IN CHARGE OF CONSTRUCTION
RESIDENT OFFICER IN CHARGE OF CONSTRUCTION
ROICC, MCLB ALBANY, GA
ROICC, NSCS ATHENS, GA
ROICC, NAS ATLANTA, GA
ROICC, BARKSDALE/ENGLAND BARKSDALE AFB, LA
ROICC, MCAS BEAUFORT, SC
ROICC, NAVHOSP BEAUFORT, SC
ROICC, NAVBASE CHARLESTON AREA CHARLESTON, SC
OICC, NAS OUTH TEXAS AREA ORPUS CHRISTI, TX
ROICC, NAS DALLAS, TX
ROICC, CBC GULFPORT AREA GULFPORT, MS
OICC, NAS JACKSONVILLE AREA JACKSONVILLE, FL
ROICC, NAS KEY WEST, FL
ROICC, NAS MEMPHIS, TN
ROICC, NAS MERIDIAN, MS
ROICC, NSGA MIAMI AREA HOMESTEAD, FL
ROICC, NSA NEW ORLEANS AREA NEW ORLEANS, LA
ROICC, ENGLAND/BARKSDALE ENGLAND AFB, LA
OICC, NTC RLANDO AREA RLANDO, FL
AROICC, NOTU C. CANAVERAL AFS C. CANAVERAL, FL
ROICC, NCSC PANAMA CITY, FL
ROICC, MCRD PARRIS ISLAND, S
ROICC, NAS PENSACOLA AREA PENSACOLA, FL
EIC, NOMTF WHITE SANDS, NM
ROICC, NAS KINGSVILLE, TX
ROICC, NAS CHASE FIELD, BEEVILLE, TX
ROICC, NAVAL WEAPONS STATION, CHARLESTON, SC

Figure 2.5 ROICC Organization--SOUTHDIV

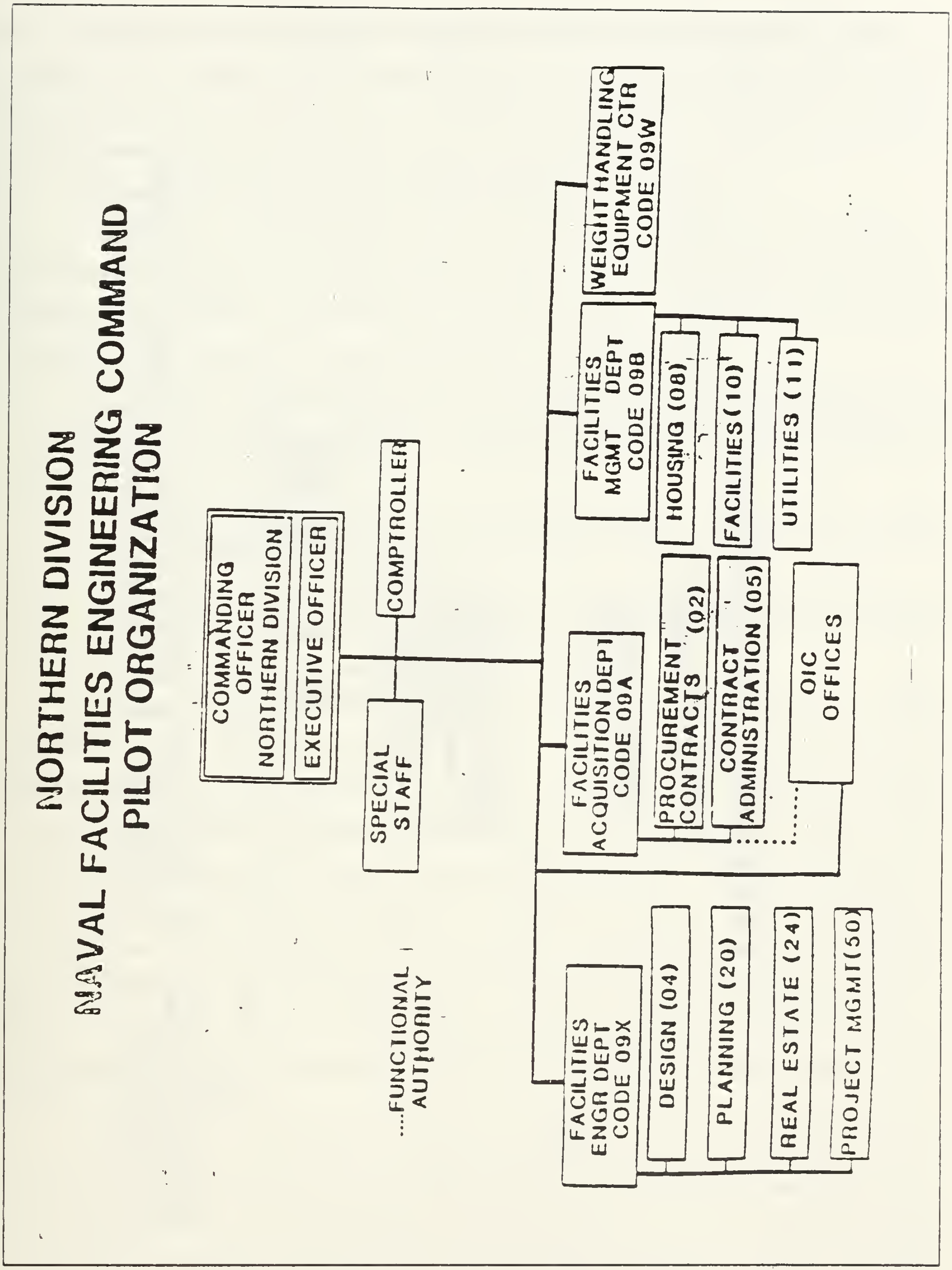

NORTHERN DIVISION
NAVAL FACILITIES ENGINEERING COMMAND
PILOT ORGANIZATION
COMMANDING OFFICER NORTHERN DIVISION
EXECUTIVE OFFICER
COMPTROLLER
SPECIAL STAFF
....FUNCTIONAL AUTHORITY
FACILITIES ENGR DEPT CODE 09X
DESIGN (04)
PLANNING (20)
REAL ESTATE (24)
PROJECT MGMT (50)
FACILITIES ACQUISITION DEPT CODE 09A
PROCUREMENT CONTRACTS (02)
CONTRACT ADMINISTRATION (05)
OIC OFFICES
FACILITIES MGMT DEPT CODE 09B
HOUSING (08)
FACILITIES (10)
UTILITIES (11)
WEIGHT HANDLING EQUIPMENT CTR CODE 09W

Figure 2.6 NORTHDIV Pilot Organization

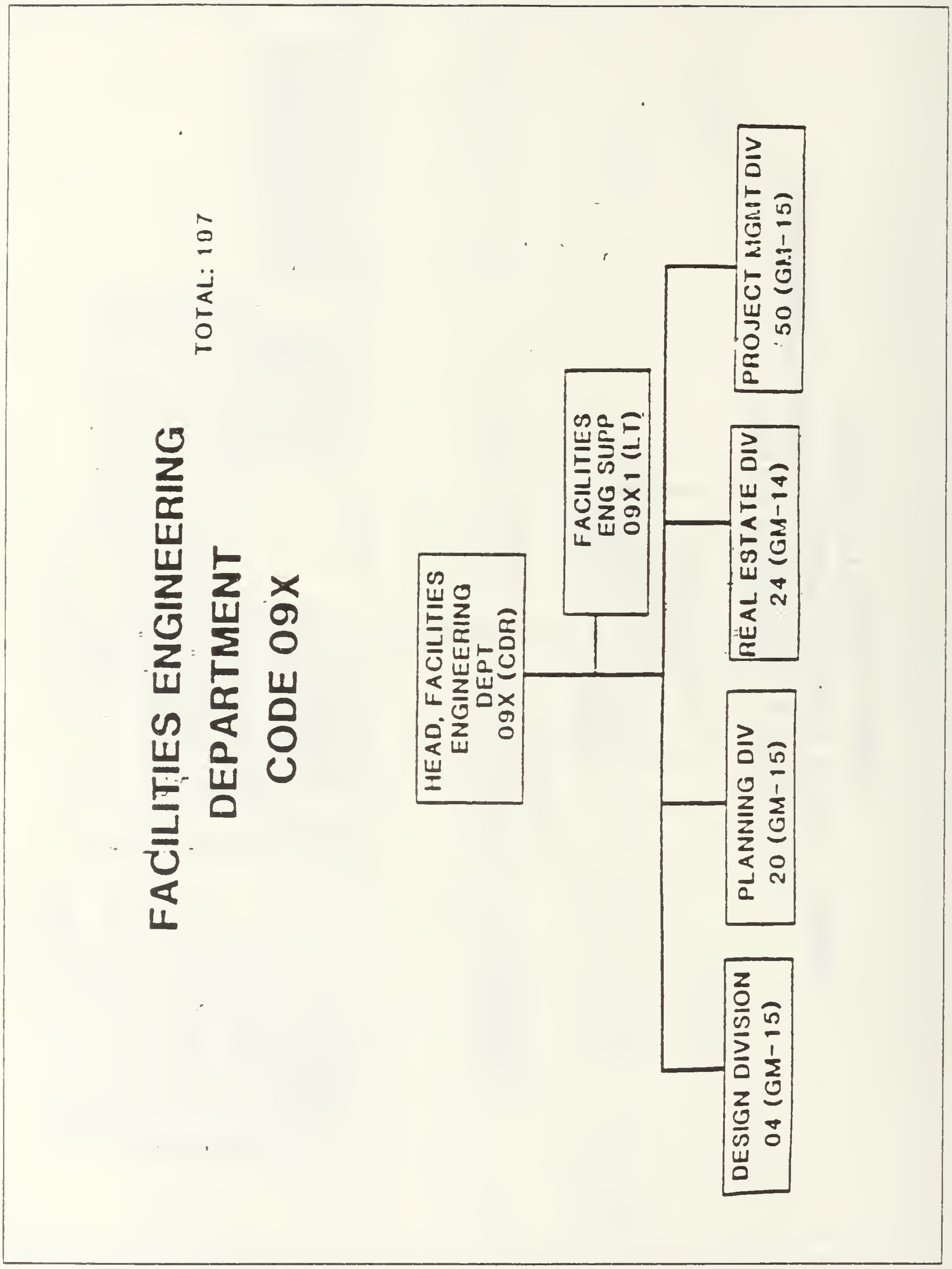

FACILITIES ENGINEERING
DEPARTMENT
CODE 09X
TOTAL: 107
HEAD, FACILITIES ENGINEERING DEPT 09X (CDR)
FACILITIES ENG SUPP 09X1 (LT)
DESIGN DIVISION 04 (GM-15)
PLANNING DIV 20 (GM-15)
REAL ESTATE DIV 24 (GM-14)
PROJECT MGMT DIV 50 (GM-15)

Figure 2.7 NORTHDIV's Facilities Engineering Department

Also, there are differences in the way each Division accounts for people. For example, at the ROICC offices some EFDs count the personnel who perform contracts administration tasks (preparation and award of contracts) as part of the 02 Division while others count these personnel as part of the 05 Division.

8. Complexities of "Universal" Divisional Budgeting Methods

While the overall missions of the EFDs are similar, and NAVFAC has promulgated a "typical" EFD organization structure, in fact, significant differences in structure and Division responsibilities exist from EFD to EFD, as shown. This complicates the manpower budgeting process in several ways:

- It frustrates the development of a universal manpower budgeting system for similar Divisions of the EFDs. For example, the specific taskings of the Contracts Division at WESTDIV differ from those at NORTHDIV. Thus, any universal process would need to take these differences into account, and would be hard pressed to do so.
- Direct comparison of productivity by EFD Division would not be ***entirely*** accurate, thus hindering the management evaluation process, and any direct comparisons between Divisions.
- The case for budgeting by segmentation, or for NAVFAC to allocate resources by Division at an EFD, is diminished. NAVFAC simply does not have the management resources to make such micro-level decisions.

9. Program Concept Facilitates Manpower Budgeting

Nonetheless, because the overall missions of the EFDs are similar, comparisons can be made EFD to EFD and a "universal" budgeting process for the EFDs is possible. That NAVFAC executes its responsibilities through a Program concept, facilitates the assignment of EFD goals and the allocation of resources. Thus, regardless of differences in Division responsibilities from EFD to EFD, the Program IV and IX goals are carried out through the integrated efforts of the entire acquisition organization. This thesis addresses the resources used for Program IV and the Facilities Support Contracts aspect of Program IX. These two Programs (IV&IX) include all of the personnel in the 05, 02, 09A1, and Project Management Divisions (09A2 or 50 depending on the EFD), and approximately 75% of the work-years consumed by the 04 Division.

The EFD Programs IX and IV workload are somewhat unique among Programs in that they are less of a ***negotiated*** tasking and more of an ***assigned*** tasking. The primary efforts of these Programs are WIP, and this WIP is primarily Military Construction (MILCON) and O&M work. MILCON is defined as "new" construction projects above a $200,000 threshold that receive approval and funding appropriation on an individual basis from Congress. The MILCON acquisition process is described in greater detail in the next section.

As MILCON is determined primarily by yearly Congressional appropriations, to a large degree it is independent of EFD influences. Similarly with O&M funded projects, which are determined by individual Naval shore activities. As will be explained in the next section, the manner by which the workload of Programs IV and IX is assigned to an EFD significantly impacts the manpower budgeting process. Of course, prior to construction work's actually proceeding on a project, design must be completed and a contract for construction awarded, both of which are governed by EFD efforts. Delays in design or contract award affect the timing of both construction efforts and resource requirements. Thus, an EFD can come under considerable pressure by "customers" to expedite the design and award of contracts. The requirement to have the right numbers of people to do the job becomes evident.

C. THE FACILITIES ACQUISITION PROCESS/MANPOWER BUDGETING PROCESS

With a background in the mission and organization of NAVFAC in hand, this next section will provide an overview of the facilities acquisition process and manpower budgeting process as it pertains to the Programs IV&IX functions at NAVFAC. This section is divided into three subsections. The first begins with the process for Military Construction (MILCON), which comprises approximately 40% of the EFDs' WIP. Also addressed are O&M funded RPM and Facility Support Contracts which are taking an increasing share of the EFDs' work efforts and are significantly impacting the manpower budgeting process. The second subsection provides an overview of the manpower budgeting and acquisition process for the Navy and NAVFAC. The final subsection addresses the effects of the facilities acquisition process on manpower budgeting.

1. Facilities Acquisition

a. Background

The acquisition of MILCON funded facilities follows DoD's Planning, Programming, and Budgeting System (PPBS). PPBS is simply a decision making process for allocating defense resources. It is a continuous process running in two-year cycles. It involves four major players at the Washington, D.C., level: Office of Management and Budget (OMB), Office of the Secretary of Defense (OSD), Joint Chiefs of Staff (JCS), and the Services. Through an iterative process the "players" move from broad planning considerations, to more definitive program objectives, to finally specific budget estimates which price-out the programs. The Planning, Programming, and Budgeting System can be summarized in a few words: Based on the anticipated ***Threat***, a ***Strategy*** is developed. Requirements of the strategy are then estimated and ***Programs*** are developed to package and execute the strategy. Finally, the costs of approved programs are ***Budgeted.*** Figure 2.8 depicts the overall PPBS process. [Ref. 10: p. A-9]

b. Planning for MILCON Projects

The planning for shore facilities acquisition occurs under the Navy's Shore Facilities Planning System (SFPS). This is a process that determines which facilities are needed to perform assigned missions, which facilities are in place and their condition, how well existing facilities are used, and what has been done to achieve efficient facilities utilization. Shore Facilities Planning consists of the following steps:

1. Assignment of missions and tasks by OPNAV to each activity of the Shore Establishment.
2. Determination of base loading. The Shore Base Loading Report, an extract from the Five Year Defense Plan, projects the assignment of men, ships, and aircraft to activities through the next five years.
3. Development of the Basic Facilities Requirements to support the assigned mission and loading, using planning criteria published by NAVFAC.
4. Comparison of approved requirements and existing assets at the activity.
5. Determination of excesses and deficiencies. Excesses are evaluated for possible conversion or disposal, and deficiencies are evaluated to determine how they may best be satisfied.
6. Submission of construction projects. For those deficiencies which must be met by construction, construction projects are developed and submitted through the major claimants to NAVFAC where they are entered in the MILCON Requirements List, a data base of all pending MILCON projects. [Ref. 11: p. 3]

The Navy can only build those projects for which Congress authorizes and appropriates funds. Congress passes separate military construction legislation each year to authorize construction projects and appropriate the necessary funds. The House and Senate Armed Services Committees, which have jurisdiction over authorization, and the Appropriation Committees, which provide Military Construction funds, have each established subcommittees to handle Military Construction matters. These four subcommittees all take an active interest in construction and review the annual program in great detail--individual construction projects which may be as small as $200,000.

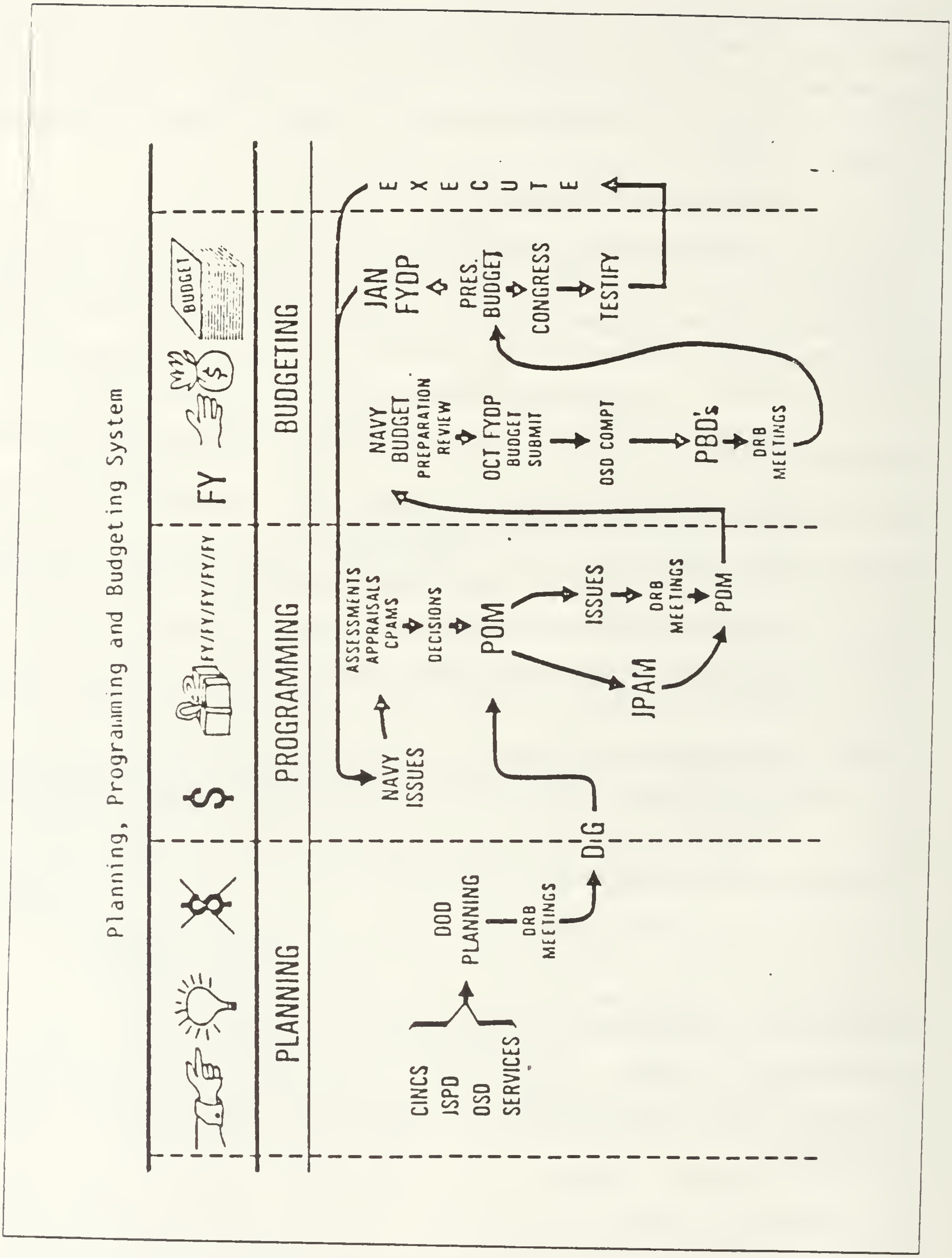


Figure 2.8 PPBS Process

c. *Programming Phase*

(1) *Background.* Most MILCON projects are not developed in isolation but are in response to "Fleet" requirements. The acquisition of new aircraft or ships and the Strategic Homeporting program are examples where a mission change or the addition of a new weapons system require new facilities to support these initiatives. As the "Fleet" goes, so does the facility acquisition program. A background is thus needed in how the Navy's response to the ***Threat*** is translated into budget line items. The Programming Phase provides this bridge.

Programming has been referred to as the art of equitably distributing resources within fiscal constraints. The basic purpose of the programming phase in PPBS is to translate the strategy into program force structures in terms of resource requirements including personnel, monies, facilities, and weapons systems. This is accomplished by systematic approval procedures that "cost out" force objectives for financial and manpower resources five years into the future. [Ref. 10: p. A-10]

The programming phase of the DoD PPBS cycle commences with the promulgation of the Defense Guidance by the Secretary of Defense. This document provides guidelines that must be observed by the JCS, the Military Departments, and Defense Agencies, in the formulation of force structures and Five Year Defense Program (FYDP). [Ref. 10: p. A-10]

The Five Year Defense Program (FYDP) is the official summary of programs approved by the Secretary of Defense. The FYDP specifies force levels in terms of major mission programs. The FYDP serves as the controlling internal working mechanism of the DoD PPB system. [Ref. 10: p. A-10]

The critical document during the Programming Phase is the Program Objectives Memorandum (POM). POM's are prepared by each of the Services in response to the Defense Guidance from SECDEF. The purpose of a POM is to express total program requirements in terms of force structure, manpower, facilities, materials and costs, to satisfy all assigned functions and responsibilities during the period of the Five Year Defense Program. The POM is developed by fiscal year and concentrates on the fiscal year that is two years in advance of the current fiscal year. [Ref. 12: p. 3-3]

About thirty days after the Services publish their Program Objective Memoranda, the JCS issue the Joint Program Assessment Memorandum (JPAM). The JPAM gives the views of the Joint Chiefs on the adequacy of the composite force and resource levels presented in the Service POMs. The SECDEF considers the Joint

Chief's analyses when deciding program issues, and his review of the Service POMs culminates in the drafting of Program Decision Memorandum (PDM). These decisions include intended adjustments in the POM submissions. Reclamas to these decisions may be submitted by the military departments; then final Program Decisions are issued. [Ref. 10: p. A-11]

(2) *MILCON Programming.* MILCON programming is essentially the evaluation of competing requirements Navy-wide to determine the resources that can be devoted to construction programs, and the evaluation of competing construction projects to select those to be accomplished within the resources available for a given program year. [Ref. 11: p. 7]

The FY 86 Military Construction Program was approved by Congress at $1.7 billion, a slight increase over the FY 85 program that was approved at $1.6 billion. The FY 87 program submitted to Congress was for $1.8 billion. The FY 88-91 programs range from $2.2 to $2.9 billion. Major items in the FY 87 budget included $198 million for the Trident program and $157 million for strategic homeporting. [Ref. 11: p. 8]

It should be emphasized that facility requirements, and the selection of a program year's MILCON projects, are determined by the "Fleet" and the entire Navy Shore Establishment, not by NAVFAC. NAVFAC acts purely in an advisory capacity during this process. For example, when the acquisition of the F/A-18 aircraft was entered into the POM, the aircraft was not a "stand-alone" package. Among other support requirements, the Navy also included in the POM facilities to house and repair the aircraft. NAVFAC entered into the picture by advising NAVAIR, the Resource Sponsor responsible for the F/A-18 program, what facilities were needed to support the aircraft.

Each year programming the correction of the Navy's facility deficiencies involves the selection of about 400 projects, only about five percent of the projects listed in the MILCON requirements list. These projects receive authorization to be designed by the EFDs to what is called the "35% completion" stage. [Ref. 11: p. 9]

d. Budgeting

Budgeting is the final phase in the PPB cycle. The annual budget expresses the financial requirements necessary to support approved programs that were developed during the preceding phases of planning and programming. It is through the budget that planning and programming are translated into annual funding requirements.

Normally, the annual Budget Submission to the Secretary of Defense is made on 15 September, twelve months prior to the applicable fiscal year. The Navy Comptroller issues the call for the submission of Budget Estimates in early June of each year prior to the budget submission to SECDEF. [Ref. 10: p. A-12]

On completion of the 35% MILCON design, this information along with more accurate cost data, is further reviewed at the CNO and NAVCOMPT levels. On completion of this review, the total program year's construction projects are submitted for formal review by the Office of the Secretary of Defense as part of the Navy's budget package. SECDEF then holds a series of budget hearings jointly with OMB on the DoD component requests. These hearings are used by SECDEF to formulate his Program Budget Decisions (PBD's), which are simply further adjustments to the Services' budgets (Programs may be cut, previously deleted ones reinstated, or existing Programs expanded). The surviving projects for each of the three services are consolidated into a unified DoD MILCON Authorization Bill and submitted to OMB for incorporation into the President's budget, which the President will submit to Congress in January preceding the fiscal year covered by the proposed budget. [Ref. 10: p. A-13]

Meanwhile NAVFAC has proceeded with 100% design of the Navy's projects. The Navy also acts as the design agent for the Marine Corps and certain Air Force and NATO projects. The final review by Congress may further eliminate projects from that year's program, or new projects may be added. Thus NAVFAC may have completed the design of a project and begun staffing particular ROICC offices, only to have construction authorization delayed until next year, or the project may never receive Congressional approval. Figure 2.9 depicts a time-line of this process.

Once funds are appropriated for construction of a MILCON project, and design is complete, the Contracts Division advertises and awards a construction contract. Once awarded the contract is turned over to the ROICC responsible for the area in which construction takes place. It is then the responsibility of the ROICC Office to administer the contract until completion. The responsibility of the other Acquisition Organization Divisions, however, does not end at this point. The Contracts Division may be called upon to provide advice on any contract modifications or, if a proposed modification (change order) exceeds the funding authority of the ROICC,

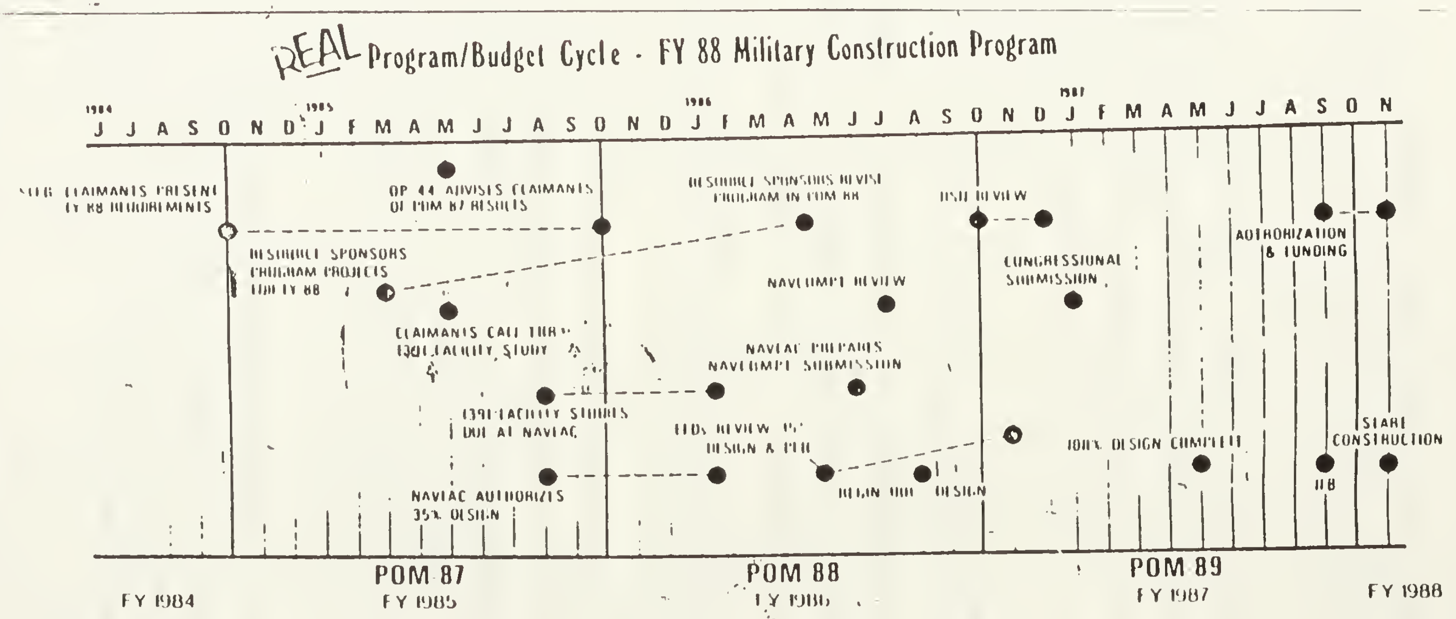


Figure 2.9 MILCON Process

this Division will have to conduct a Business Clearance and negotiate the modification--a very time consuming process. The Design Division may be called upon to provide engineering advice or to perform design and cost estimation for a change order. The total of these efforts influences the need for manpower staffing, yet may not be reflected in standard workload statistics. Interviews of Contracts Division personnel indicated that providing consultation and advice to ROICC Offices, much of which required time-consuming research effort, was a "significant" part of their daily efforts. However, no statistics are maintained on number of consultations, etc.

e. Operations and Maintenance Funded Projects

Activity Commanding Officers have authority, using their station O&M funds, to perform minor construction and alteration projects not to exceed $25,000, and repair projects not to exceed $75,000. Through a Special Project submission process activities can receive up to $200,000 in O&M funds from their Major Claimant to perform minor construction and alteration projects. There is no dollar limitation to Major Claimant O&M funded repair projects [Ref. 13: p. 32]. There is, of course, course, strict guidance on what constitutes a construction project and what is a repair project. O&M funded projects do not receive the same Congressional scrutiny as do MILCON projects and do not have to individually go through the five year PPB process to receive funding. Special Projects submitted by activities are reviewed by Major Claimants annually and must compete for limited O&M funds on the basis of priority and urgency. Needless to say, only a small percentage of Special Projects submitted by activities are funded. Design and construction contracts for these projects are awarded by local OICCs and administered by local ROICC offices. EFDs only get involved in O&M projects that exceed the contracting authority of the local OICC.

2. Manpower Acquisition Process

Navy manpower requirements are included as part of the PPB process. Manpower requirements are first introduced into the system during development of the POM and then follow through the PPB process as with the acquisition of any other resource. As mentioned earlier, NAVFAC is not the "prime mover" in the facilities programming process. It simply acts in an advisory capacity to the "Fleet" in the programming of MILCON projects. However, NAVFAC is responsible for facilities acquisition once MILCON projects are programmed, and thus it must determine its personnel requirements to carry out this mission. As such, during the POM process, NAVFAC is responsible to the Deputy Chief of Naval Operations (Manpower, Personnel, and Training) for providing its (NAVFAC's) requirements, not only for the budget year, but for five years hence [Ref. 12: p. 3-4]. As will be shown in the remainder of this chapter, this task (not an easy one to begin with) is complicated by numerous quirks of the "system" and "outside" factors other than workload. Since the Naval Material Command was abolished, NAVFAC now "stands alone" as a Systems Command and must be able to defend its budget before Congress, as must any of the Operating Force Commands. With a manpower budget approaching $140 million, the need for a credible manpower forecasting system is evident.

3. Effects of the Acquisition Process on Manpower Staffing

The nuances of the facilities acquisition process have particular effects on manpower budgeting. These effects can be divided into three main categories: forecasting, stability, and continuity.

a. Forecasting

Starting with MILCON, the structure of this budget process facilitates workload forecasting for the EFDs. Starting with the Design Division, since the primary workload of this Division is MILCON projects, they can (and do) examine the current year's MILCON authorization bill before Congress, or the pending selection of projects for 35% design from the MILCON requirements list, to forecast their workload and develop a manpower budget. Similarly the Contracts Division, which primarily awards contracts for Architect-Engineer design, and construction, of MILCON projects, is able to forecast workload and develop a manpower budget system. The Construction Division, using the CMS management information system, is also able to project ROICC workload up to 18 months in advance, and thus staff their offices accordingly.

Special Projects and activity funded O&M projects are much more difficult to forecast, and because of the increased dollar value and number of projects these contracts comprise of a ROICC's workload, strong implications exist for manpower staffing. These projects can be funded at any time during a fiscal year. Activity level projects in particular go through no formal approval process. Therefore, it is difficult for a local ROICC office to predict the volume of these projects that it will have to award and administer. Additionally, O&M funded projects are more administration effort-intensive for a ROICC office than MILCON funded new construction projects. O&M funded projects consist primarily of Real Property Maintenance or Repair projects and Facility Support contracts. While these contracts comprise about 30% of an EFD's WIP they make-up more than 75% of the total number of projects; in contrast, MILCON funded projects comprise nearly half of NAVFAC's WIP but account for less than 15% of the total number of projects.[9] It is much more difficult to communicate in contractual terms how to perform facility repair or maintenance than it is to start from ground-zero and a build a new one. This carries over to to inspection and administration effort. As a result, change orders, or unplanned changes to a contract, generally considered worse than the plague at a ROICC office because of the effort required to negotiate and document the change order, are several percentage points higher per dollar of WIP for Real Property Maintenance projects, or Facility Support Contracts than new construction MILCON projects.[10]

Generally, ROICC offices and EFDs forecast O&M workload solely based on past history, and staff accordingly.

b. Stability

Unfortunately, virtually everything mentioned about the ease of forecasting MILCON workload goes "out the window" when considering stability. Project stability is a particularly frustrating aspect of the MILCON process for the EFD acquisition organization. Stability refers to the volume of projects that drop out, are radically changed, or are delayed, after approval has been received to commence 35% design. Figure 2.10 depicts this situation for the FY 87 MCON (Military Construction, Navy) program. This figure shows that more than one-quarter of projects authorized for final design were not approved by Congress for funding in the fiscal year for which construction of the project was originally planned. The causes for this situation are numerous: changing mission, "pork-barrel" politics in Congress, lack of funds, changed priorities by Major Claimants, etc.

What are the consequences of Program instability? Consider again the timeline for the budget process. About the time the President is submitting his budget to Congress a tentative OP-Plan is being developed between NAVFAC and the EFDs. While Congressional hearings are being held concerning MILCON projects, NAVFAC is finishing project design, and planning--and implementing--personnel staffing for ROICC Offices. The major problem caused by lack of program stability is the inability of EFDs to rapidly shift resources from one Division to another or from one ROICC office to another. Thus, WESTDIV might increase staffing at the ROICC office in El

---

[9] Source: NAVFAC Code 05

[10] Source: NAVFAC Code 05

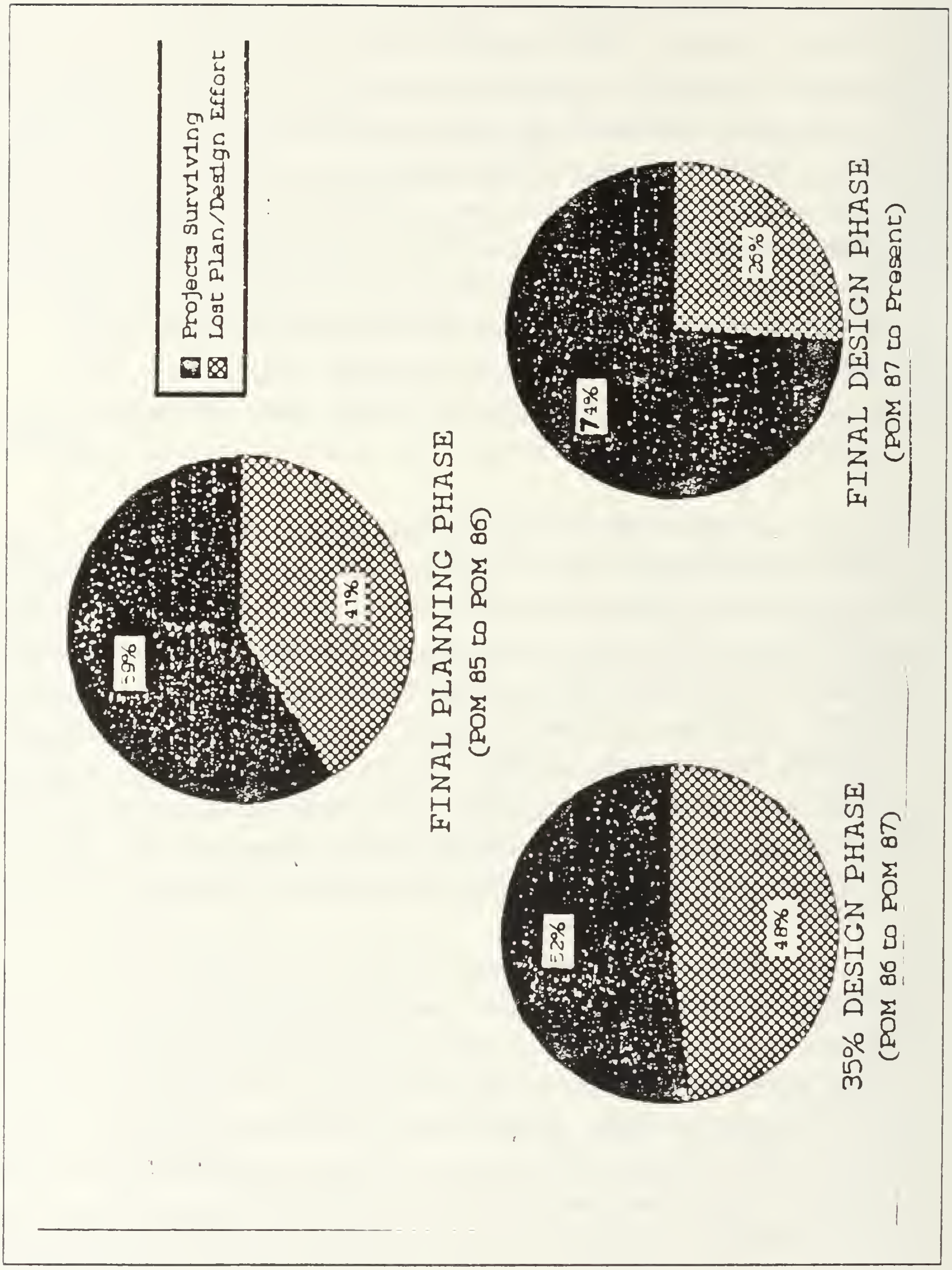


Figure 2.10 MILCON Stability

Toro, California, only to find that the projects forecasted for this office have been dropped from the MILCON program, while at ROICC Fallon, Nevada, two major MILCON projects that were placed "on hold" several years ago suddenly receive approval, because the Congressman from that district now serves on the House Armed Services Committee and can influence approval of those projects.

Stability also affects staffing statistics. For example, an EFD may increase staffing in anticipation of a large workload for a particular program year, and then have a large percentage of these projects delayed or eliminated from the program. As a result, their "productivity" statistics may be deceptively low, prompting questioning of efficiency and management practices.

Additionally, projects may be designed to the 35% stage, only to have the customer determine that the design is something other than what is ***really*** desired, and thus an EFD may need to start the design again from ground zero. All EFD Design Directors interviewed indicated that this was more than just a rare occurrence, and these efforts were not measured in the EFD's final DIP output. In fact, no accurate statistics were maintained on this situation. The effect of this situation is that actual design work effort is not truly depicted in standard workload-to-staffing statistics, which may be used to compare design productivity of EFDs.

Stability is a factor built-in to the budgeting system, and EFDs plan for a certain amount of program instability. However, stability is not a methodical aspect of the budgeting process. It is purely random. Thus, an EFD may experience high program instability in one year and virtually none the next. Unfortunately, statistics on program stability by EFD were not available to make comparisons, but all EFDs indicated this was a problem.

c. *Continuity*

Continuity refers to fluctuations in the EFD and ROICC workload over time. Figure 2.11 depicts the CONUS EFDs' WIP (constant FY 79 $) from FY 79-86. As can be seen, although WIP per EFD has increased over this period, it has not done so on any linear basis; rather, it has been more on a random basis. Tables 3, 4, 5 and 6 show, for each EFD, the numbers of ROICC Offices divided into three categories based on WIP for FY 83-86. The categories are: small office ($0-10 million WIP), medium office ($10-20 million WIP), and large office (greater than $20 million WIP). The last column shows the number of offices that changed more than two categories during this period, excluding any linear increase or decrease. As can be seen, there is much shifting of categories. Figures 2.12 and 2.13 depict EFD OICC awarded contracts from FY 82-86. Again, the numbers bear no relationship from year-to-year. Figure 2.14 presents design-in-place by EFD from FY 83-86 (constant FY 86 S). The results are the same. With the EFDs' workload fluctuating as shown, it is difficult to justify staffing increases to meet a large workload one year when the projections for the next year are for a decrease in workload. Quite simply, an EFD cannot hire and fire senior engineers and contract specialists--the personnel needed for Programs IV and IX--just to have a consistent workload-to-staffing ratio. The staffing policy has been, however, not to seek middle ground staffing to have slightly excess personnel during "slack" periods and being slightly understaffed during peak periods, but to staff very conservatively. Figure 2.15 shows the work-year/WIP ratio for FY 84-86 (constant FY 79S). As shown, all of the EFDs except WESTDIV have experienced declining WY/WIP ratios, generally indicating staffing has declined with respect to workload.

D. FURTHER COMPLEXITIES

The manpower staffing process for NAVFAC is further complicated by numerous factors that may be unique to an EFD, to a Division, to a ROICC office, or even to a particular project. Many of these factors may be "one-time" influences, particular to only a certain construction project. For example, the construction of a sophisticated communications facility may require more labor hours of administration effort than for construction of a warehouse. Additionally, these "other" factors tend to be largely unquantifiable. How, for example, can a number or value be assigned to the level of experience of the personnel in a ROICC office? Yet, a ROICC office with highly experienced personnel will need a smaller staff than a ROICC office with similar workload but with a staff largely consisting of inexperienced personnel.

A number of these factors were gathered through interviews with EFD Acquisition Organization Division Directors and with the Army Corps of Engineers. They are presented here, divided into two categories: EFD/Division level and ROICC Office/project level. ***The purpose of presenting these staffing factors is to recognize the complexity of manpower staffing and set the stage for determining methods of dealing with these factors.***

1. EFD/Division Level

Interviews indicated there are nine primary factors (other than workload and those described in the previous sections of this thesis) that affect staffing. These are (not in any order of precedence):

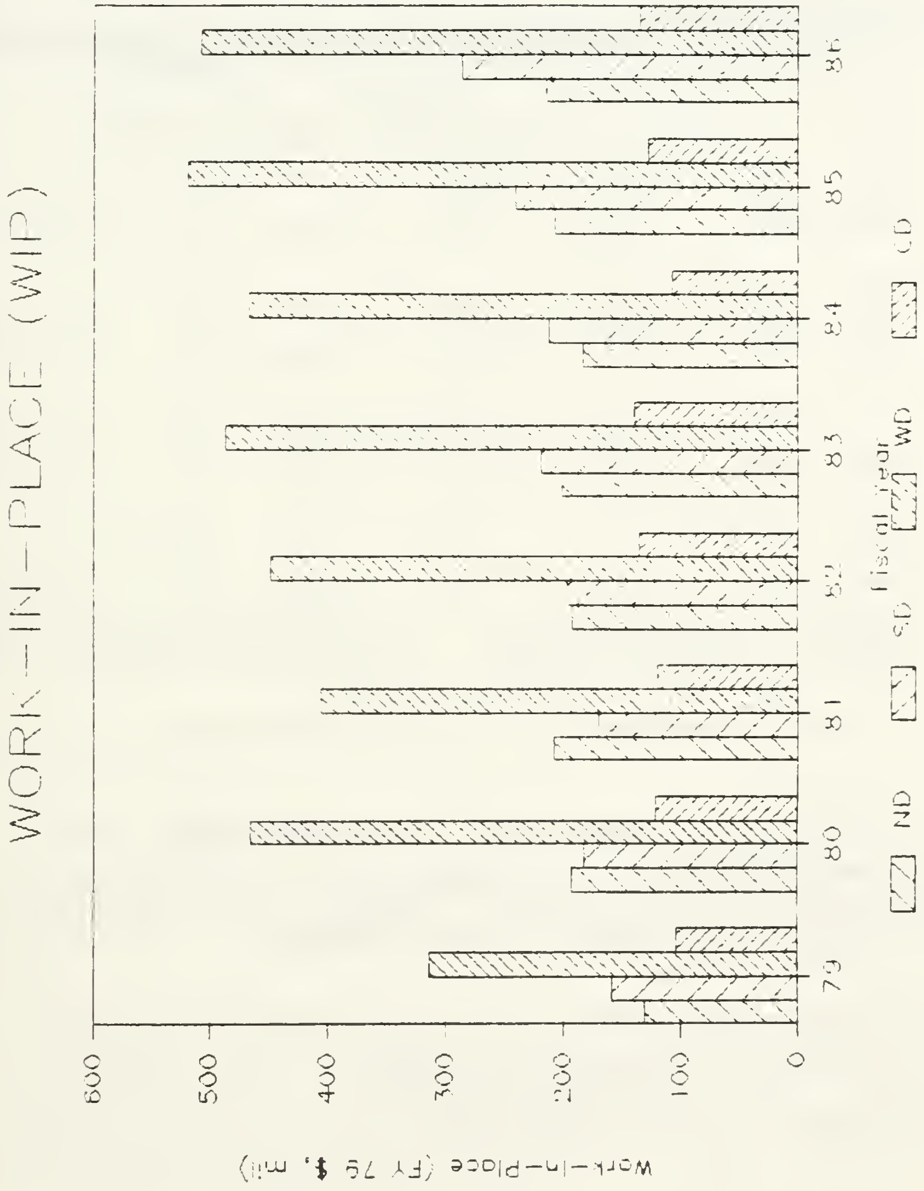


Figure 2.11 Work-In-Place

TABLE 3

NORTHDIV ROICC WIP CATEGORIES

First row: No. ROICC Offices per WIP Category (WIP $mil)
Second row: Percent Total WIP by Category

FY	WIP $0-10	$11-20	>$20	#ch
83	8	7	3	
%tot WIP	15	41	44	
84	10	6	3	
%tot WIP	19	38	43	
85	9	6	5	
%tot WIP	13	28	59	
86	9	7	4	3
%tot WIP	10	40	50	

Source: CMS data base
WIP in constant FY 86$, millions

- Dispersion and Geographical location of Field Offices
- Demographics/area costs of areas served
- Political considerations/"Visibility" of projects
- Economy of Scale
- Climate of areas served
- Experience level/turnover of personnel
- Type of projects (MILCON, RPM, etc.)
- Unique missions
- Quality of Work

Dispersion/Location of Field offices affects (1) travel time by headquarters staff to these offices, (2) the ability of an EFD to shift resources from one field office to another to cope with workload changes, and (3) the ability of an EFD to recruit staff for a particular office.

TABLE 4

SOUTHDIV ROICC WIP CATEGORIES

First row: No. ROICC Offices per WIP Category (WIP $mil)
Second row: Percent Total WIP by Category

		WIP		
FY	$0-10	$11-20	$>20	#ch
83	15	5	4	
%tot WIP	19	27	54	
84	15	6	3	
%tot WIP	20	31	49	
85	12	7	5	
%tot WIP	14	26	60	
86	13	4	7	3
%tot WIP	15	15	68	

Source: NAVFAC CMS data base
WIP in constant FY 86 $, millions

Addressing these in order:

1. The Naval activities served by SOUTHDIV and WESTDIV are particularly dispersed from the EFD headquarters and travel time to these offices is a consideration in staffing. Generally, it was felt that the more isolated an office, the fewer visits and inspections would be made by headquarters staff to that office.

2. WESTDIV and CHESDIV have concentrations of field offices in particular areas. For WESTDIV, these include the San Diego and San Francisco areas. For CHESDIV, this is primarily the Washington, D. C., area. Manpower resources in these areas are more easily shifted from office to office than for isolated field (ROICC) offices. If the latter were facing a two-year downturn or upturn in construction work a more permanent hiring decision would have to be made instead of internally (to the EFD) shifting resources, such as could be done in areas concentrated with field offices.

3. The more isolated the field office, such as Adak, Alaska, or Fallon, Nevada, the more difficult it is to recruit and retain personnel. Thus, an EFD may make a conscious decision to retain qualified staff at an isolated ROICC office even when that office faces a downturn in construction, because it may be difficult to recruit personnel when there is a future upturn in workload. Conversely, an EFD may not be able to recruit enough qualified personnel for an office, and that office may be continually understaffed. Such is the case with ROICC Camp Pendelton, California. To make up this shortfall, WESTDIV is increasing the staffing of Navy Civil Engineer Corps Officers, many of whom are performing jobs previously done by civilians. However, due to Congressionally imposed

TABLE 5

WESTDIV ROICC WIP CATEGORIES

First row: No. ROICC Offices per WIP Category (WIP $mil)
Second row: Percent Total WIP by Category

		WIP		
FY	$0-10	$11-20	$>20	#ch
83	6	5	9	
%tot WIP	6	15	79	
84	7	1	15	
%tot WIP	6	10	93	
85	6	6	12	
%tot WIP	4	10	86	
86	8	2	14	4
%tot WIP	6	4	90	

Source: NAVFAC CMS data base
WIP in constant FY 86 $, millions

ceiling levels on the total number of CEC Officers, this is not a viable across-the-board option.

Demographics/area costs affect the ability of an EFD to recruit and retain qualified personnel. Government salaries do not vary with location. Thus WESTDIV and CHESDIV, whose areas of responsibilities are concentrated in the high cost areas of coastal California and Washington, D.C., can pay their employees no more than SOUTHDIV and NORTHDIV, whose areas of responsibility are predominantly in areas of lower cost. Put another way, engineers and other highly skilled people are more inclined to work and remain under the employ of the government at SOUTHDIV and NORTHDIV than at CHESDIV and WESTDIV. This aspect was particularly emphasized in numerous interviews.

Economy of Scale is an economics term and essentially means that a larger organization should be able to accomplish proportionately more work than a smaller organization because of more efficient use of labor, work specialization, etc., until

TABLE 6

CHESDIV ROICC WIP CATEGORIES

First row: No. ROICC Offices per WIP Category (WIP $mil)
Second row: Percent Total WIP by Category

FY	$0-10	WIP $11-20	$>20	#ch
83	1	3	5	
%tot WIP	5	28	67	
84	1	6	2	
%tot WIP	6	64	30	
85	1	5	3	
%tot WIP	4	46	50	
86	1	5	4	2
%tot WIP	4	48	48	

Source: NAVFAC CMS data base
WIP in constant FY 86 $, millions

diseconomy of scale occurs, which essentially means that the organization has become so large management cannot effectively control it. From outward appearances, then, WESTDIV should experience greater economy of scale than the other EFDs. Appearances, however, can be deceiving. In fact, WESTDIV has grown so large, and its activities are so dispersed, that senior management at WESTDIV argue that their EFD is experiencing diseconomy of scale. A feasibility study is now underway to consider dividing WESTDIV into *three* EFDs. Given the disparity in sizes of EFDs (in terms of manpower and workload), economy of scale is potentially a major factor in staffing. The question is, how can it be measured? A related question is, how to isolate the measurement of economy of scale from the numerous other factors that affect an EFD's staffing and work output? Tables 7 and 8 present interesting information regarding this area. Table 7 shows, by EFD for FY 84-86, design-in-place, Design Division work-years expended in performing the DIP, and the DIP/WY ratio, which is

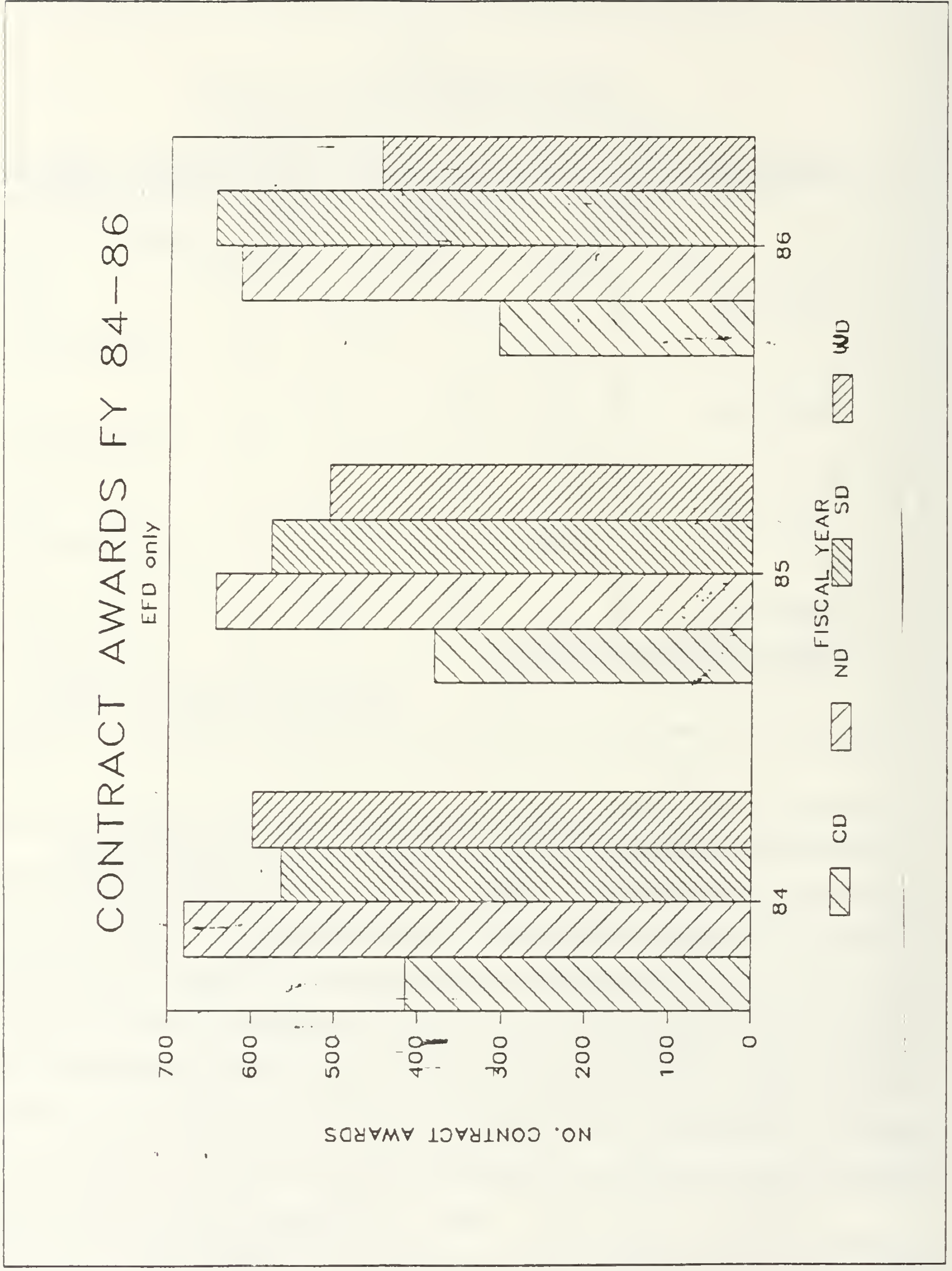


Figure 2.12 Contracts Awarded (EFD)

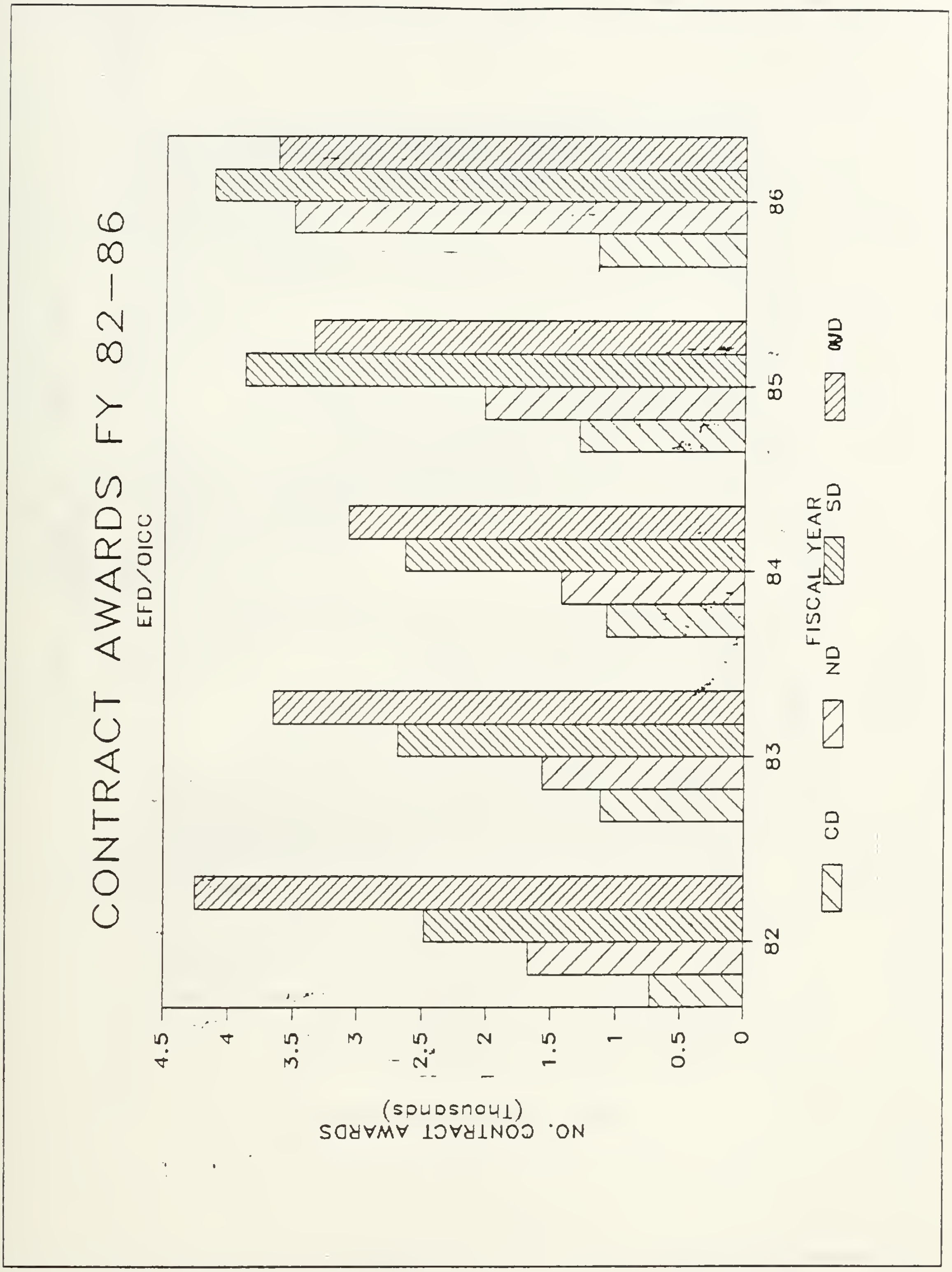


Figure 2.13 Contracts Awarded (EFD/OICC)

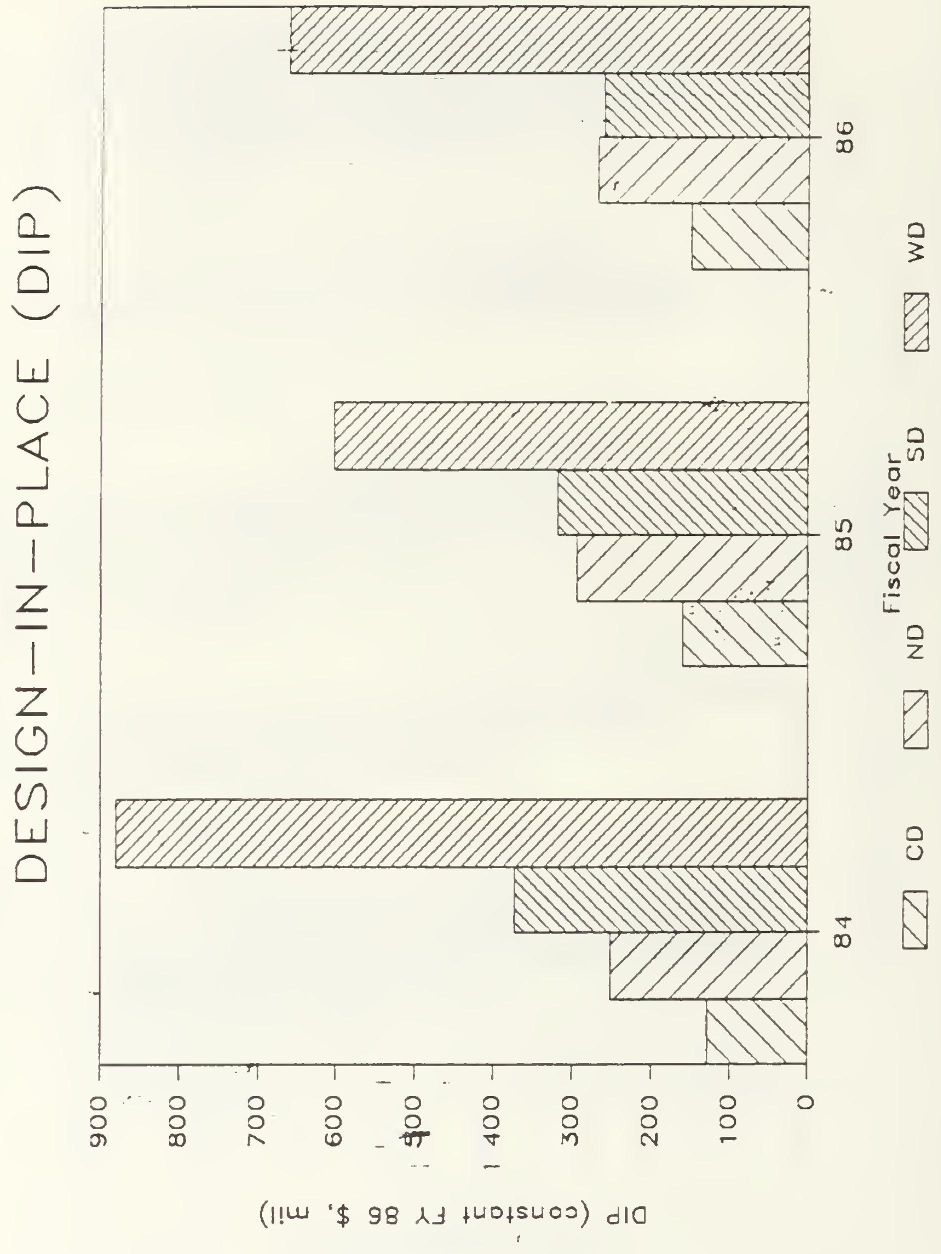


Figure 2.14 Design-In-Place

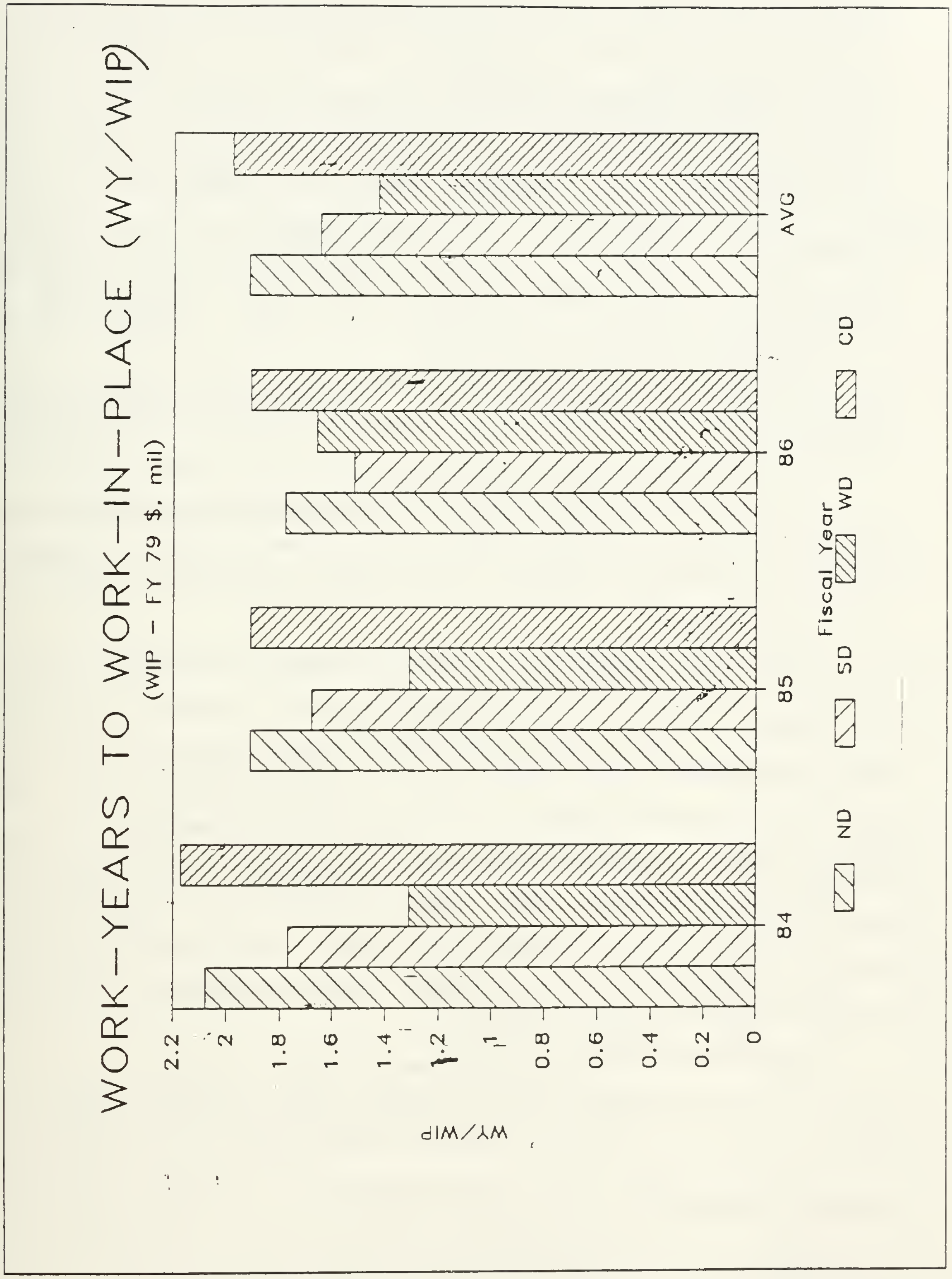


Figure 2.15 Work-Year to WIP

a *rough* measure of productivity (the amount of DIP per one work-year of effort). This Table shows that WESTDIV, which had a substantially larger Design Division than the other EFDs, had greater "productivity" during the three years surveyed. In FY 84 it produced $5.26 million DIP for each Design Division work-year expended, compared to less than half that for CHESDIV. However, SOUTHDIV, which had the next largest Design Division, had the second highest "productivity" for two years, but was significantly lower in the third. As previously explained, however, raw DIP numbers are are not completely accurate measures of 04 output. Therefore, this table is considered a *general* indicator of productivity.

Results of a similar analysis are shown in Table 8, which relates WIP to EFD staffing. A *possible* interpretation of this table is the larger the EFD staffing, the more "productive" it is.

Although Tables 7 and 8 are presented primarily for informational purposes a cautious conclusion from these tables is that economy of scale is a factor to be considered in manpower staffing. To what *extent* it should be considered will be addressed in Chapter IV.

Interestingly, **climate** is also a factor in staffing. NORTHDIV, which has a concentration of offices in the New England and Great Lakes areas, and WESTDIV, with offices in the Pacific Northwest and Adak, Alaska, must contend with adverse weather conditions during at least a third of the year. Climate has the effect of restricting the times of the year when construction can be accomplished. Thus, ROICC offices in Gulfport, Mississippi, and Brunswick, Maine, may perform similar amounts of WIP and each administer similar numbers of contracts, but because of climate, ROICC Gulfport may have these projects spread over an entire year, whereas ROICC Brunswick may have this work concentrated during the summer months, thus requiring more personnel to administer the contracts.

Experience level/turnover of personnel is really a by-product of the first two factors discussed--dispersion/geography and demographics/area costs. Simply put, the greater the experience level of an office or Division, the greater the productivity. Statistics gathered indicate that at the headquarters level WESTDIV experienced the highest level of turnover in the Acquisition Organization with a turnover rate averaging more than 20% over the past three years. SOUTHDIV, with the lowest, had less than half that figure. Concern over this statistic was voiced both at NAVFAC and the EFD level.

TABLE 7
DESIGN-IN-PLACE AND 04 WORK-YEAR DATA

	FY 84			FY 85			FY 86		
EFD	DIP	WY	DIP/ WY	DIP	WY	DIP/ WY	DIP	WY	DIP/ WY
CD	128	53	2.4	161	54	3.0	149	51	2.9
ND	251	82	3.0	295	82	3.2	268	83	3.3
SD	373	102	3.7	319	96	3.3	261	96	2.7
WD	881	168	5.3	603	171	3.6	661	172	3.8

Design-In-Place (DIP) in constant FY 86 $, millions

Source: NAVFAC IPMS and CMS data base systems

TABLE 8
WORK-IN-PLACE AND EFD WORK-YEAR DATA

	FY 84			FY 85			FY 86		
EFD	WIP	WY	WIP/WY	WIP	WY	WIP/WY	WIP	WY	WIP/WY
CD	107	247	.43	128	260	.50	135	278	.48
ND	183	430	.43	207	450	.46	214	430	.50
SD	212	385	.55	241	420	.57	286	439	.65
WD	467	690	.68	519	740	.70	508	896	.56

WIP in constant FY 79 $, millions (EFD WIP only)

Source: NAVFAC IPMS and CMS data base systems

The mixture of an EFDs' total WIP by **fund source** is an indicator of workload complexity and administrative difficulty for an EFD. It is also why "raw" WIP data does not tell the "true" story of an EFD's workload and why Table 8 is only a general indicator of EFD productivity. New start MILCON projects require less administration effort per dollar of WIP than O&M funded Real Property Maintenance (RPM) projects. Because RPM projects outnumber MILCON projects by nearly five to one, but comprise less than 30% of an EFD's WIP, it is much less time consuming to administer one dollar of MILCON WIP, which may equate to just one project, than it is to administer one dollar of O&M Real Property Maintenance WIP, which may be the result of five projects. Put another way, one man-hour of RPM effort generates less WIP than one man-hour of MILCON WIP. If the reasoning is not apparent, consider the paperwork workload alone in administering, per WIP dollar, five times as many RPM projects as MILCON projects. Statistics for FY 84-86 show that, per total WIP by EFD, SOUTHDIV had highest percentage of MILCON WIP and, interestingly enough, the highest percentage of O&M funded RPM and Facility Support WIP. As will be shown in the next chapter, through statistical analysis, WIP fund source will be developed into the "best" indicator of work effort for an EFD.

Two terms must be introduced at this point to facilitate understanding of NAVFAC's manpower budgeting system. Among the various means of classifying work-in-place (WIP), one method is to distinguish between *Income Bearing* WIP and *Non-Income Bearing* WIP. Income bearing WIP includes MILCON, which comprises approximately 60% of the total, Industrial Fund, Reimbursables and Family Housing (can also be considered MILCON). For these fund sources of WIP NAVFAC receives a percentage fee called SIOH (Supervision, Inspection and Overhead) for administering the project. This percentage fee varies from 3%-6% of the construction value of the project, depending on the WIP fund source, and is "paid" either by Congress (for MILCON) or by the customer (Major Claimant) for whom NAVFAC is administering the project. NAVFAC receives no fee for non-income bearing WIP, which consists of O&M funded RPM and Facility Support Contracts.

WIP can also be classified by fund source. There are eight primary WIP fund sources:

1. Real Property Maintenance WIP consists of minor construction work funded by O&M funds.
2. Naval Industrial Fund (NIF).
3. Family Housing WIP includes all major and minor repair work and maintenance service work.
4. Other Direct Costs (ODC) including civil work and RDT&E, represent locally accepted work at the EFD/ROICC level, performed for a non-Navy activity, such as the Air Force.

5. Reimbursable WIP.
6. MILCON WIP.
7. Facility Support Contracts (non-income bearing). Commonly called FAC 0%.
8. Facility Support Contracts (income bearing). Commonly called FAC 3%.

NAVFAC, which formerly went by the title "Bureau of Yards and Docks," has been in the facility acquisition business for over 50 years. Yet, during this time the development of a comprehensive indicator of the **quality** of the facility acquisition process, or even one primary aspect of it, has eluded Navy managers. The following paragraphs address quality of facility acquisition and its affect on manpower staffing.

At first thought, one might think that the quality of a construction project (the culmination of the acquisition process) might be as easily measured as, say, the quality of a car. Unfortunately, it is not so simple. To begin with, facilities have much longer useful lives than cars. While statistics could be gathered showing how many Ford Escorts that were sold in 1975 are still on the road today, accurate statistics regarding shore facilities are either not available or are not meaningful. For example, many facilities built during WW II were intended for *temporary* use. The fact that they were torn down within 10 years or are still in existence today (and many still are; one need only visit Fort Ord, or Pearl Harbor, to verify this) does not necessarily attest to their quality. More likely, it is testimony to the limited funding the military allocates to the acquisition of new facilities.

The need for facility maintenance or repair might also be considered an indicator of quality. Yet statistics in this area are even less available, or no more reliable an indicator of quality than those for life span. The Navy still has a sizeable inventory of "temporary" facilities that have been put to "permanent" use. These facilities have certainly required substantial maintenance and repair that would influence any EFDs' data base. Then there are newer facilities. The problem with any maintenance statistic on these are the numerous factors that might contribute to it, including a more-than-likely sizeable lag period between the time the facility was built and the time maintenance was needed. For example, consider a repair to an air conditioning system for a building one year after construction was completed. Was the repair necessitated because of faulty work done by the contractor who installed it, and thus indicative of inadequate ROICC inspection efforts? Or was it caused by poor quality manufacturing, in which case the government could really not have detected the problem? Or maybe it was caused by the Architect-Engineer specifying the wrong type of unit or inadvertently undersizing the system, thus causing it to overwork in handling the cooling load and accelerating deterioration. In such a case, the Design Division might be responsible for such a fault. Or, maybe the unit was *deliberately* undersized because funding was scarce and the facility had to be built with at least *some* air conditioning. This line of argument could easily be continued and data base of this information expanded out of proportion to any benefits received.

One possible measure of quality is an EFD's change order rate. A change order (in the context of this section) is a change to an *original* construction contract. NAVFAC maintains an extensive data base on change orders, cataloging change orders into more than 20 different categories, ranging from "customer requested," to unforseen site conditions, to design errors. The latter is potentially indicative of the quality of effort of not only the Design Division but the ROICC staff as well. A change order due to design fault can have numerous causes. Some examples are: A dimension on the structural drawings may not coincide with that on the architectural drawings. Thus, a contractor may have built according to the architectural drawings, and a change may need to be made in locating a wall or column; the designer may have neglected to specify a vapor barrier for the concrete foundation and a change order must be negotiated with the contractor to install a vapor barrier. Theoretically, diligent review of the plans and specifications by the Design Division, and later the ROICC staff in the field, should catch these problems *before* a contract is awarded. The reason attempts are made to avoid change orders is that the contractor is no longer competing against other bidders in pricing these changes; instead, he is *negotiating* the price, with a great deal of leverage on his side. In reality, a detailed review of the plans and specifications--primarily prepared by an outside Architect-Engineer--by the Design Division and the ROICC is very time consuming and not all errors are easily caught. However, the change order rate due to design error can be considered a measure of the quality of effort by 04, and to a lesser extent, the ROICC staff.

Taking this possible measure of quality one step further and assessing its effects on manpower staffing, in order to support the argument that an an EFD or a particular Division is understaffed, a manager *might* be able to say, "We are producing as much WIP as the other EFDs, but we are having to do it with less people, and this is showing up in the quality of our work; therefore, we need more people." An attempt to create such a scenario is reflected in Table 9, which is to be read in conjunction with Table 7. The two columns for each fiscal year show design-in-place per Design Division work-year, a *rough* measure of output per labor effort, and percent value of change orders *due to faulty design.* Theoretically, the larger DIP/WY ratio, which might be a rough indicator that an EFD was understaffed and having to produce too much DIP for the staffing level (it *also* might indicate economy of scale, as previously shown), the larger the percent change order value due to faulty design. Unfortunately, only a small sample of data--FY 84 and FY 85--was available. In FY 84 one might argue that this hypothesis was true because WESTDIV, with the highest DIP/WY ratio, also had the highest percent change order value. However, FY 85 data fails to corroborate this hypothesis.

TABLE 9

DESIGN-IN-PLACE AND CHANGE ORDER DATA

	FY 84		FY 85	
EFD	DIP/WY	C/O%	DIP/WY	C/O%
CD	2.38	2.06	3.03	3.04
ND	3.03	2.41	3.22	1.98
SD	3.7	1.7	3.33	1.68
WD	5.26	3.2	3.57	2.3

DIP in constant FY 86 $, millions

Change order percentage = $Value of C/O divided by Total Contract Value

Source: FACSO report on EFD Change Orders

Continuing with the effects of "quality" on staffing, NAVFAC does evaluate, or compare, EFD facility acquisition performance through a system of Management by Objectives, which is embodied in the OP-Plan. As stated in NAVFAC Instruction 5220.11, *Goal Progress Reporting System*:

> The fulcrum of NAVFACENGCOM management is embodied in the Operating Plan, which sets forth the Command's programs, functions, and goals, together with the plan for the allocation of all Command resources for a given fiscal year.
>
> One of the essential ingredients to the proper management of any enterprise is the ability to objectively and accurately identify, in a timely manner, the

> success being achieved in furtherance of the stated goals of the organization. This is the purpose of the Goal Progress Reporting System (GPRS).
>
> Thus, the Operating Plan forms the basis for GPRS by identifying the functions to be performed during the fiscal year and establishing specific goals to be achieved in each functional area.
>
> The GPRS provides for a semi-annual Goal Progress Report as to the status of progress made toward the achievement of all the goals set forth in the Operating Plan . . . Program Managers have defined for each function only the goals which are new initiatives for the year and support the attainment of program objectives. [Ref. 14: p. 5]

One of the problems in comparing EFD performance through the GPRS is that OP-Plan goals for Program IV are largely quantitative, such as goals for the amount of WIP and DIP. *Quality* of facility acquisition is still a very elusive concept. Moreover, because there are multiple goals for Program IV, there is an inherent drawback to evaluating an EFD's performance, as well as use and needs of resources, through the GPRS. As stated by W. F. Ridgway in his article, *Dysfunctional Consequences of Performance Measurement*:

> The mounting interest in and application of tools . . . foster the idea that if progress toward goals can be measured, efforts and resources can be more rationally managed . . . .
>
> Quantitative measures of performance are tools, and are undoubtedly useful. But research indicates that indiscriminate use and undue confidence and reliance in them result from insufficient knowledge of the full effects and consequences. Judicious use of a tool requires awareness of possible side effects and reactions.
>
> The use of multiple criteria (of performance measurement) assumes that the individual will commit his or the organization's efforts, attention, and resources in greater measure to those activities which promise to contribute the greatest improvement to overall performance . . . .
>
> Without a single overall composite measure of performance, the individual is forced to rely upon his judgement as to whether increased effort on one criterion improves overall performance, or whether there may be a reduction in performance on some other criterion which will outweigh the increase in the first. [Ref. 15: pp. 240-246]

Interviews with NAVFAC personnel indicated that progress in meeting OP-Plan goals is not used in determining future allocation of resources to the EFDs for virtually the reasons described in Ridgway's article. If an EFD Commander determines the need to increase DIP because projects are backlogged at this stage, or he decides the Design Division is handicapped by a shortage of experienced personnel, he may allocate proportionately greater resources to this Division, regardless of the effect on achieving Op-Plan goals in other Divisional areas.

In subsection A.2.a of this chapter, the question of where an EFD Commander can receive the greatest "marginal return" on his labor investment was raised. Interviews with EFD personnel indicated several schools of thought on this subject. The two prime considerations in answering this question were: Where do bottlenecks occur in the facilities acquisition process, and what Division can best improve the quality of the end product--the actual facility--with the addition of one more work-year of labor? Or, conversely, given that an EFD does not obtain the work-year allocation requested, from what Division can he reduce the allocation to receive the least "marginal reduction" in overall performance? Addressing the first consideration, an informal survey revealed that bottlenecks of equal severity can occur at any point in the facilities acquisition process to delay final completion of a construction project. For example, the Contracts Division could be late in awarding an A-E contract to commence design of the project; the Design Division could delay the actual design work; or, once the construction contract was awarded and under the responsibility of the ROICC, construction could be delayed because the ROICC was late in approving shop drawings or in approving a change order. Apparently no help for the EFD Commander there. The concept of marginal return on *quality* provoked different responses. The general consensus--although there were dissenters--indicated that the Design Division or Project Management Division had the greatest effect on quality of the finished product. General reasoning was that once a design is completed, and done well, it is a straightforward matter for the construction contractor to build the facility because he has "quality" plans and specifications, and the job of the ROICC is made easier because there are fewer disputes with the contractor over interpretations of the contract documents and fewer change orders due to faulty design needing to be negotiated. The unusual part of these responses was that there was no consistent definition of design quality. Responses ranged from designs that produced "fewest change orders," to "best 'workmanship'," to "satisfied customers." Liberal interpretation of these comments indicates these are areas that any Acquisition Organization Division can influence, and in many projects all three do not coincide. For example, quality workmanship does not necessarily mean fewer change orders. Additionally, the Construction Division ROICC Offices are the staff closest to the actual project and their efforts in contract administration and design review can certainly produce a "satisfied" customer, can enforce quality workmanship, and can produce fewer change orders. The Contracts Division, while not as intimately involved in the actual project construction, is involved with the selection of the project designer, assists in the interpretation and enforcement of contract provisions, and participates in the negotiation of change orders. All of this contributes to acquisition quality, attributed by some just to the Design or Project Management Divisions.

In conclusion, it is considered most difficult to answer the question, "Where can an EFD Commander receive the best marginal return for his labor effort?", and no means exist for using any "quality" indicators as the impetus for changes in manpower staffing, because there is no concrete definition of quality.

The **visibility** of a project may play more of a role in staffing the field offices than EFD-level staffing, but consideration must be given to the position CHESDIV occupies as the EFD serving the top echelon of the Federal Government and the Military. CHESDIV is responsible for facilities acquisition in the Washington, DC, area, and the "visibility buck" stops there. Staffing "considerations" are provided to CHESDIV for this responsibility.

Three of the CONUS EFDs have ***unique missions*** in Program IV. These taskings use Program IV resources but do not contribute to the standard output of WIP or DIP. The graphs and tables in this thesis that incorporate Program IV resources (work-years) exclude the resources used in executing these unique taskings. These are:

- NORTHDIV: administers NAVFAC's Weight Handling Equipment Program.
- CHESDIV: administers the Ocean Facilities Program
- WESTDIV: oversees the ROICC Pacific Division, which provides construction support to PACDIV.

These taskings require less than 10% of the respective EFDs' Acquisition Organization resources and are staffed "automatically" by NAVFAC. They are mentioned here because in several articles previously written on NAVFAC Program IV staffing, statistics comparing the EFDs did not take into account these special missions.

2. ROICC/Project Level

Most or all of the same factors that influence staffing at the EFD level affect ROICC Office staffing. In fact, there is a large overlap. There are, however, additional factors peculiar to ROICC Offices and projects:

- Project complexity (high technology);
- "Personalities" in an office;
- Security considerations, such as construction of the Trident facilities;

- Size of area served by a ROICC Office;
- Age of installations served by a ROICC Office;
- Reputation/Capabilities of contractors in an area, or performing a specific job;
- Experience level/capabilities of ROICC personnel;
- Capabilities/experience of Architect-Engineer who designed a particular project;
- "Visibility" of a project;
- Reputation/rank of the Commanding Officer whose Naval Base is served by a particular ROICC Office.

Interviews indicated that each of these factors is assessed when staffing a ROICC Office. Considering that ROICC staff comprises nearly 60% of the Acquisition Organization, and approximately one-third of an EFD's personnel, the manager for Program IV needs all the help he can get when making the resource allocation decision.

E. SUMMARY

In Chapter I it was stated that manpower staffing is not an exact science. For NAVFAC many reasons have been presented in this chapter. The Program managers at NAVFAC and the EFDs must have some logical and sound means of addressing the question: "How many people do we need?" From outward appearances, this chapter may have only served to complicate matters further. The next chapter describes some of the textbook solutions to manpower staffing and assesses the practicality of NAVFAC's adopting some of these solutions for its own use.

III. METHODOLOGY OF DEMAND FORECASTING

A. INTRODUCTION

Scene: Board meeting at the Acme Construction Company

George Slone (Chairman and Chief executive): Exhibit A is our planned budget and our objective for next year. I'd appreciate your comments.

Martha Kemp (outside director): George, I note that overall you are projecting a modest amount of growth for next year. You also have had a series of increased worker productivity projects going to cut employee costs. Things like word processing stations in all work centers, access to sophisticated data processing systems, computer aided design, and better contract inspection procedures. I also know that on our government contracts we've had to adhere more strictly to the MilSpecs, and the paper work to comply with the new Federal Acquisition Regulations has tripled. Just how many people will you employ next year to reach your sales and profit objectives?

George: That's a good question, Martha. I don't know exactly. John, what's the answer?

John Que (Vice President, Personnel): That's hard to say. It depends on lots of factors.

Martha: Frankly, John, that's not much of an answer. I can look at the figures in this exhibit and see how much money we need. The marketing people tell me how many units they are going to sell. Why can't you tell me how many people we'll need to get the job done--our people-cost figure?

John could have answered Martha's question if Acme's personnel department had developed an effective manpower demand forecasting system.

The above scenario might be repeated numerous times at board meetings all over America. In the private sector, where budgets are more flexible and hiring practices less rigid than the public sector, the absence of certainty in the business climate compared to say, the DoD budget, lessens the requirement for strict accuracy in the manpower forecasting system.

NAVFAC enjoys no such flexibility luxuries when dealing with competing for manpower resources through the POM process and in the Additionally, this flexibility is further lessened when considering the types needed for Programs IV and IX. These are primarily professional engi tradespeople, and Contract Specialists. The recruitment and training of people of these skills is much more time consuming than a lesser skilled work force and thus much longer lead times must be allowed during the hiring process. NAVFAC really must "live" by its manpower forecasting system, which not only must be accurate in forecasting "true" needs but also must have a large degree of credibility, be significant, and be cost-effective [Ref. 2: p. 853].

1. Criteria for a Good Manpower Forecast

The need for credibility may be intuitively obvious, but the latter two? Actually, digressing to credibility, the personal credibility of a Civil Engineer Corps Rear Admiral testifying before Congress may get NAVFAC some mileage, but it is far safer if it can be explained how the forecast was made, or at least what assumptions are behind it.

What about a forecast being significant? If forecasts merely confirm what is intuitively obvious, there is not much value to the forecasting process. The payoff of forecasting is in identifying the large manpower changes that are in store given changes in the environment.

Finally, a forecast must be cost-effective. At the NAVFAC level there is not much chance that a forecast could *not* be cost-effective. Or is there? In trying to clarify what the future may hold, it is appealing to keep adding refinements to the forecasting process. In the macro sense, cost effectiveness implies simplicity. Overly complex forecasting methods can easily lose credibility, and thus a point of diminishing returns can be passed when adding forecasting factors to a model. The importance of cost-effectiveness can be more easily acknowledged in manpower forecasting at the micro, EFD division level, where the actual cost of a forecast, such as maintaining a data base, can easily exceed the benefits.

For example, NAVFAC uses an extensive data base system for construction and resource-use information. While this data base is invaluable to management and NAVFAC's operation, it is expensive to maintain. Every employee must complete labor cards indicating cost account code and labor hours used for jobs worked. This information must then be collated and input into the data base system. A staff of

Information System specialists writes programs to extract specialized information. The collective labor hours involved is extensive. At the Division level, if such a data base system were not in place, or the NAVFAC system did not collect information specific enough for that Division to use in forecasting manpower requirements, the costs involved in implementing a new system, or customizing the existing, might exceed any savings gained from improved forecasting accuracy.

2. Chapter Organization

The remainder of this chapter provides a brief background on manpower planning in the Navy, then continues by describing the techniques of developing a macro-level demand-forecasting system on the order that NAVFAC requires for the POM process. Refinements to the macro-level system are then considered for allocating resources from NAVFAC to the EFD level. Finally, in general terms, techniques are described for use at the department/division level. Further chapters in this thesis draw on this chapter to evaluate current NAVFAC and EFD systems and to recommend improvements.

This chapter draws on writings from the Navy and Air Force Manpower Engineering Programs, as well as several civilian periodicals. While this chapter uses the NAVFAC organization as an example, the information provided is equally applicable to any organization, civilian or government.

However, one might wonder why NAVFAC does not adopt a specific system already in use by another civilian or government agency. NAVFAC does use established *methods*, but the uniqueness of its mission precludes direct adoption of another system. This situation was discussed at some length at the beginning of Chapter II.

B. MANPOWER PLANNING IN THE NAVY

Manpower planning for the Navy shore establishment falls under the cognizance of the Deputy CNO for Manpower, Personnel and Training. The Navy Directive that controls the manpower planning process is the Navy's *Manual of Navy Total Force Manpower, Policies and Procedures.* One of the primary purposes of this manual is "to provide tasking for the effective determination of manpower requirements and the effective management of authorized manpower resources." [Ref. 12: p. 1-2] Theoretically, the Navy's Shore billets are determined by SHORSTAMPS (Shore Requirements, Standards, and Manpower Planning System). As stated in the directive:

> SHORSTAMPS is an application of proven industrial and management engineering principles for determining the total manpower requirements for the Navy shore establishment. SHORSTAMPS is comprised of the Shore Required Operational Capability (SHOROC) subsystem of standard tasking phrases and the Navy staffing standards subsystem . . .
>
> The SHOROC is a subsystem of SHORSTAMPS which is used in the tasking of Navy shore activities through a structured tasking vocabulary. SHOROC specifies tasks and defines how much, how long, and how well tasks will be performed . . . .
>
> The SHOROC provides a management decision tool for manpower planners at all levels of command. [Ref. 12: p. 2-17]

The goal of SHORSTAMPS is three-fold:

- Provide staffing standards for functions performed ashore, based on recognized management and industrial engineering techniques and objective determination of workload.
- Provide a system for the assembly of manpower requirements information at the various levels above the activity level, to support Navy manpower requirements during all stages of the PPB process.
- Provide the methodologies and systems to assess present, and forecast future manpower requirements. [Ref. 12: p. 2-1]

In reality, SHORSTAMPS has never fulfilled the objectives of its designers, and its provisions are now less than rigidly enforced. It proved too inflexible, staffing standards were costly to develop, and many staffing standards that were developed were of questionable accuracy. Industrial engineering techniques to determine manpower staffing, which were espoused by SHORSTAMPS, were simply not suitable for many organizations. SHORSTAMPS is still the Navy's primary tool in manpower forecasting, but it has been supplemented--and in some cases superceded--by judgmental and other less scientific methods. Nonetheless, much of the SHORSTAMPS methods used in developing staffing standards are sound, and this Chapter refers to these methods often.

C. NAVFAC LEVEL

At the macro level there are two primary methods of manpower forecasting: trend projection and modeling/multi-predictive. Both are called "top down" methods. Trend projection develops a forecast based on a past relationship between a factor related to staffing and staffing itself. For example, in many businesses, sales levels are related to employment needs, and so the personnel planner can develop a table or graph showing past relationships between sales and employment. For NAVFAC, Programs IV and IX staffing levels might be related to projected WIP or number of contracts awarded. The important requirement that this factor must fulfill is that it be causally related to manpower needs: A change in the volume of this factor must change the manpower input requirements. [Ref. 3: p. 111]

Modeling and multi-predictive techniques are the most sophisticated. While trend projections are based on relating a single factor to staffing, the more advanced projections relate many factors--such as WIP, number of contract awards, number of active contracts, and projected value of design-- to staffing. The major criterion to use in the selection of output units to measure (i.e. WIP, sales dollars, number of customers served, etc.) is that to increase the production of these outputs there must be a corresponding increase in the number of input units (i.e. labor). As stated by Bruce Coleman in his article, *An Integrated System for Manpower Planning*:

> For an organization which sells its output, the dollar value of its goods and services is an appropriate measure of output. For government, educational, military, and similar institutions, a dollar value for services is not available. For most activities inside a company, a dollar value does not exist for production efforts, except perhaps where profit or cost centers exist.
>
> When there is no dollar value to measure output, a physical unit of measurement is used. Vouchers processed or customers served are typical units. Determination of appropriate physical output units may be difficult. The unit selected should respond to changes in labor inputs, and labor requirements should change as the volume of the output changes. In addition, the relationships should be useful over time. In other words, the output selected is not one that the firm will cease producing in the near future or one that will become only a minor part of its activities. [Ref. 16: p. 90]

Although primary output of EFD Programs IV and IX efforts can be measured in dollars, such as work-in-place or design-in-place (DIP), these outputs, or workload, are subject to distortion. The problem with using "raw" WIP data is, as explained in Chapter II, that this data does not distinguish if one million dollars in WIP represented one MILCON project or five O&M-funded projects (the actual ratio that these projects occur). And it is generally much more effort-intensive to administer five eighty-thousand dollar projects than one four hundred thousand dollar project. Similarly, "raw" DIP numbers do not "tell the entire story," although not for the same reason as WIP ("raw" DIP, however, is generally considered more accurate in reflecting administration effort than "raw" WIP). This is because EFDs, for the most part, do not administer small dollar value O&M design work. This is done at the Public Works or ROICC level. EFD Design Divisions primarily oversee large MILCON design projects. An example illustrates why DIP value does not translate with complete accuracy into relative labor effort: It takes more effort to design and oversee a $10 million road and parking lot paving project than a $5 million sophisticated telecommunica

Thus WIP and DIP alone must be used with caution as causal factors.

Once such possible output, or causal, factors are identified, it is p

regression analysis to find the "best fit" staffing equation to predict input r

A note of clarification may be in order to explain how WIP and DIP can be "causal factors" for EFD labor requirements when labor must be in place *before* WIP and DIP can be produced. Design workload and construction workload are *assigned* to NAVFAC or an EFD and, in turn, NAVFAC/EFDs must determine how many people they need to accomplish this tasking. Thus WIP and DIP, which are assigned taskings, *cause* staffing requirements.

1. Limitations

At the macro-level, forecasting methods are largely statistical and look primarily at the "big picture." Subjective methods such as expert judgment, the Delphi technique, and bottom-up or segmentation approaches play a lesser role. However, statistical approaches are not without their limitations. Any purely statistical approach to forecasting has an inherent bias--a bias in favor of the past [Ref. 17: p. 158]. The statistical analysis tells us what will happen if past patterns and relationships continue into the future. But is this a reasonable assumption? Numerous situations could occur to invalidate that assumption:

- Introduction of new methods or equipment could substantially improve productivity. At NAVFAC the use of computers in design, word processing, record keeping, and contract processing has exploded over the past ten years.
- Reorganization could phase out some jobs and create others.
- Changes in government regulations, such as implementation of the Federal Acquisition Regulations, has streamlined the contracting process, while the outcry over $1200 coffee makers has made the process much more deliberate.

As stated in an article by James W. Walker:

> Vetter has also noted another serious drawback to most of the computer based simulation models that have been advanced. If projections are made on the basis of historical data only, then there is a concealed assumption that the future is going to be like the past, and the past thus comes to exercise a kind of tyranny over the future. When historical data are used exclusively, to be specific, there is no consideration of what 'ought to be' in staffing the organization, as opposed to 'what has been.' The general point here is that in forecasting from historical data alone there is a built-in incapacity to optimize the utilization of human resources. Hopefully future models will avoid this pitfall. [Ref. 17: p. 158]

To address part of Walker's statement, when forecasting at the macro-level it may not be realistic to be thinking in terms of what ought to be. That is really to be done at the divisional level, a point that will be addressed later in this chapter. Another means of macro-level forecasting that may be well-suited to addressing an organization's needs is forecasting by segmentation. The specific methodology of this process is explained later in this chapter. As stated by Walker:

> Organizational segmentation, of course, simplifies the problem by foreshortening the need for a total forecasting model. Even where the organization in question is not primarily segmented, projections may thus be improved by focusing on segments of a work force; more realistic parameters may be established and greater specificity in projections may be possible. [Ref. 17: p. 156]

It has been proposed that in forecasting for Programs IV and IX requirements NAVFAC build their request to Congress from the bottom up, simply collating the requirements generated by the EFD's. At the POM level, however, this method would be too unwieldy in justifying requirements to Congress. NAVFAC needs an uncomplicated, understandable (at the Congressional level) system that meets the criteria stated earlier for an effective manpower forecasting system. Segmentation would not be persuasive in showing changes in manpower requirements given changes in workload level. Segmentation may be better used by NAVFAC in allocating resources to the EFDs, and, in fact, it is used by NAVFAC to some extent.

D. VALUE OF STATISTICAL ANALYSIS

At the macro level it is apparent that purely statistical methods are inherently limited by a bias towards the past. They are also limited in that one-time events or special factors are difficult, if not impossible, to quantify in a regression equation. The public outcry over the excessive prices paid for spare parts is an example. Within months of this crisis, the EFD Code 02 (Contract) Divisions saw their staffing double or even triple in order to provide improved contract support. Does this limitation invalidate the use of statistical analysis for forecasting? In a word, no. It has been suggested that the use of statistical analysis does not rule out the exercise of expert judgment and experience; rather this type of analyses enables judgment and experience to focus on those parts of the problem that are properly matters for judgment and experience. As stated by Richard Fantzreb:

> Analysis illuminates the problem and may provide hard answers to part of the problem. Ultimately, however, the decision maker must come to grips with those factors which are unknown or uncertain but about which professional experience of judgment is sometimes helpful. Without the preliminary analysis

> few decision makers would know which particular facet of the problem was deserving of their professional judgment. Analysis thus becomes the handmaiden of judgement--not its antithesis. [Ref. 2: p. 853]

E. EFD LEVEL

At the second echelon of NAVFAC's manpower budgeting process, that of allocating resources among the EFDs, statistical methods such as modeling are still the primary tool, but judgment and additional modeling factors, such as number and types of activities served, must be included to account for the unique aspects of each EFD. The model may have to become more complex in terms of number of predictive variables, which may require an expanded data base. Many of the unique characteristics of an EFD will not be able to be quantified (realistically), such as experience level of personnel, capabilities of specific contractors, economy of scale of operations, political considerations, geographical locations, etc. Judgment on the part of the Program manager thus plays a more important role at this level. It is here the previous quotation may be particularly apt. As Gareth Stainer says in *Manpower Planning: The Management of Human Resources*, "The aim in employing statistical or other techniques is to simplify the problem to the extent that the human mind can cope with it efficiently, rather than to eliminate subjective judgment altogether." James Walker expresses a similar thought: "To estimate future requirements, someone must make a decision. Mathematical analysis and massive data may be useful, but ultimately, the determination of 'how should we be staffed' is a human decision." [Ref. 2: p. 855]

It is interesting to note that the Logistics Management Institute, which is currently under contract to the Army Corps of Engineers to produce a divisional level manpower forecasting system, is attempting to quantify the aforementioned "unique characteristics." This development will be discussed further in Chapter IV.

F. DIVISION LEVEL FORECASTING

In budgeting at the division level, that is, allocating Program resources among the 02, 05, 04, and 09A2 divisions, the process can be refined--and made more complicated--easily by an order of magnitude. All the techniques applicable at the macro and second-echelon levels are applicable at the divisional level, but there is a significant refinement of subjective methods to include "expert estimate" and Delphi techniques. The former method involves an "expert" forecasting the manpower needs based on experience and intuition. The Delphi technique involves repeated interactions of subjective, written estimates by a number of managers obtained by questionnaire and administered and collected anonymously. When information is collected, it is summarized and redistributed to participants for consideration of the reasoning behind all the individual estimates. The cycle is repeated until an agreement is reached. The keys to this technique are precise problem definition, questioning and feedback. [Ref. 3: pp. 111-112]

The case for subjective forecasts may sound like a tenuous one. It may actually sound as though we are giving up trying to forecast and just asking people to guess about manpower requirements. Generally, this will not be the case. As stated by Richard Fantzreb:

> Relying on the subjective judgment of individuals does not mean that the process of eliciting that judgment will be without guidance, without motivation to take the task seriously, or without controls over the quality of the result. Judgemental forecasting can be done poorly, or it can be done well. [Ref. 2: p. 855]

There is at least one caveat with subjective methods. At the division or unit level, subjective methods are useful, but they must be tempered with the awareness that a manager may not be careful to distinguish between "need to have" and "nice to have," or not really be able to distinguish between the two. As trend analysis has a built-in bias towards the past because it uses *past* data and *past* circumstances to predict *future* requirements in which circumstances may have changed, an overstaffing situation may easily be perpetuated by subjective methods, as well. How, then, can this situation be addressed?

G. WORK MEASUREMENT AND THE MOST-EFFICIENT-ORGANIZATION CONCEPT

Most organizations are naturally dynamic and thus do not enjoy a status quo. Therefore, every organization, no matter how large or small, needs to be examined periodically in a cold, objective light to determine whether it has grown fat with unnecessary work, which adds little to the primary effort, and to see if personnel are being properly utilized and numbers of people to do the work are neither too high nor too low. How to do? By a combination of management analysis, industrial engineering techniques, and statistical applications. [Ref. 18: p. 15]

The goal through this section is, quite simply, to determine if manpower is efficiently and effectively used and, if so, develop manpower standards to develop the most valid work-center man-hour-to-workload relationship possible to predict or estimate manpower needs. The determination of efficiency/effectiveness involves the concept of Most Efficient Organization (MEO). Many people may be familiar with MEO from the implementation of OMB Circular A-76, the Commercial Activities program. Under A-76, the Government has been required to compete with private enterprise for performance of certain services, such as public works functions, Automated Data Processing services, etc. To successfully compete in the marketplace, government organizations had to come up with MEOs, or the smallest-staffed organization to perform the assigned mission. The profit motive has required civilian organizations to operate "lean and mean" (or more so than government organizations) simply to survive in a competitive world. Heretofore, the government had operated under no such constraints, and most government managers had no idea how to get their organizations in to "fighting trim." Thus, there has been recent emphasis on educating government managers in developing MEOs.

To arrive at a MEO a process called an Efficiency Review (ER) is performed. In an ER, potential efficiencies are sought to streamline the organization and its work processes. To arrive at a MEO, which is a pre-requisite for determining an accurate manpower standard, a step-by-step, almost cookbook process is performed. This process is outlined in the following paragraph and then briefly described.

1. Perform Activity Overview
2. Perform Organizational Analysis
3. Perform System Process Charting
4. Identify Workload Indicators
5. Identify Potential Efficiencies

Performing an Activity Overview involves determining mission and tasking, reviewing activity instructions, identifying interrelationships with other activities, and reviewing historical data such as resources expended and outputs produced. Historical trends may not provide conclusions but, rather, information which may point to possible efficiencies. For example, if the number of contracts acts awarded has fallen 25% over a period, but manning in the contracts office has remained stable, a potential efficiency has been identified.

The next step is to perform an Organizational Analysis by reviewing the current organization charts and tasks as shown in the organization manual and activity instructions. Examining the charts can determine if there are any possible efficiencies to be gained by restructuring the organization. Organizational areas that give rise to possible efficiencies include:

- Fragmentation, i.e., multiple units of minimal size;
- Multiple levels that limit delegation of authority and restrict information flow;
- Duplicate functions;
- Excessive overhead.

The structure of an organization should aim for:

- The smallest number of organizational units and levels feasible;
- A minimum ratio of supervisors to nonsupervisory personnel to maintain span of control;
- Deputy and assistant staff positions only when essential.

The next step is to perform System Process Charting, which portrays the interrelationships of man, material, and paper work within the organization. Only the more lucrative systems, in terms of potential savings, should be charted. Analysis of the current system can lead to the identification of many possible efficiencies:

- Duplication of effort;
- Generation of reports that are not used;
- Lack of set procedures to handle frequently occurring exceptions;
- Unnecessary procedural steps.

One of the most important steps is the identification of Workload Indicators. Analysis of Workload Indicators is essential in determining a work center's/organization's output in relation to input. Workload Indicators explain what drives the man-hours expended in the performance of assigned tasking. Examples of Workload Indicators might be number of contracts awarded, number of projects designed, etc. Workload Indicators provide a basis for:

- Supporting manpower aspects of the budget.
- Planning and assigning work.
- Reviewing workload forecasts and manpower use.
- Measuring the efficiency of the organization.
- Developing staffing equations.

There now exists a complete description of the organization's scope, work performed, and input and output factors.

The most important step, step 5, is the identification of Potential Efficiencies. This is really a culmination of the previous steps. There are many types of problems that create the opportunity for method improvement and increased efficiency. Clues can be derived from information collected. In particular, analysis of System Process Charts, Organizational Analysis, etc. An excellent method is *expert* observation of the organization. Sometimes a potential efficiency can be identified simply because a problem is seen happening once, and then research is done to confirm that it happens frequently.

Included in this step is the sometimes difficult, but necessary task of quantifying the man-hour impact when an improvement, identified from a potential efficiency, is implemented. This task is necessary to identify the "true" time or effort required in the production of historical output. This result will be used in determining the staffing standard equation.

Once the MEO is developed the manager can proceed to the last step.

1. Developing the Manpower Standard

The objective of the manpower-standards-development process is to determine an organization's/work center's man-hour-to-workload relationship and quantify manpower requirements. Simply, manpower standards relate manpower requirements to workload volume. The Air Force classifies standards into two main types [Ref. 21: p. 4-1]:

- Type I standards are developed by determining man-hours required to do a job through the use of standard time data, time study, work sampling, or a combination of these techniques. The resulting standard reflects time to perform a given workload. Of the divisions at an EFD, only 02 (contracts) might be suitable for a Type I standard.
- A standard is characterized as Type II when the work is not appropriate for engineered methods, or a large, minimum staff is required which is to a great extent, independent of workload in a broad minimum-to-maximum range. This characterizes the 09A2 organization in particular, and the 05 ROICC offices. Alternate methods must be used for forecasting requirements in such cases, such as using regression analysis to find the "best fit" staffing equation based on established workload factors and MEO input data, or forecasting by segmentation.

There are three phases in the development of a standard: (1) Measurement Design, (2) Work Measurement and Data Collection, (3) Data Analysis, Computations, and Model Development. [Ref. 21: pp. 6-8]

Measurement Design identifies what data are needed and how to measure the work and collect the data for developing a manpower standard. The major products of this effort are the identification of Workload Factors and what type of engineering measurement method to use to measure man-hours required. Workload Factors were identified during the Efficiency Review phase and are those factors that explain what drives the man-hours expended by an organization. Essentially, they are those outputs the volume of which will have a causal effect on the number of input resources required, i.e., number of contracts awarded, etc. Care must be taken when identifying these workload factors. As mentioned earlier, WIP and DIP are two major outputs of Program Programs IV and IX at EFDs. However, straight values are misleading. The choice of engineering measurement methods include work sampling, time study, etc.

The Work Measurement and Data Collection phase is as its name implies.

The Data Analysis and Computation phase uses statistical methods to develop regression equations that best fit the data. In work centers such as 02 that have types of work that are suited to time-study techniques, labor hours taken to produce each output are measured. Then, given a projected volume of workload, the labor hours per output are multiplied by the projected output to get total labor hours. Indirect labor is usually constant within a given range of direct labor and this is just added on to get total manpower requirements.

Three of the EFD Program IV work centers (04, 05 and 09A2) are not suited for engineering measurements of required manpower, and even development of a Type II Division-wide staffing-standard equation is difficult for the 05 ROICC organization and the Project Management Division. In these Divisions there is a significant fixed minimum staffing level. Comparing workload factors to labor input for the variable staffing level is made difficult because the segmented organizational structure of these Divisions qualifies even a Division-level staffing standard. For example, the Construction Division may forecast a 10% increase in WIP for the next year. However, this increase may be dispersed over all the ROICC offices, and each office is able to handle the increased workload without adding any additional staff. Thus, a 10% workload realistically may not translate to *any* additional staffing requirements for 05. These Divisions are better suited to budgeting by segmentation. A single Division-wide staffing equation would not be an accurate means of manpower forecasting. The question is, then, can a mathematical model be developed to facilitate budgeting by segmentation and to augment purely judgmental forecasting methods? The answer is yes, and is addressed in Chapter IV.

2. Section Summary

The preceding section really falls under the category of theoretical or textbook management. It is interesting to note that the Navy Manpower Engineering Centers, which were responsible for performing Efficiency Reviews and developing Manpower Standards under SHORSTAMPS, were disbanded by SECNAV Lehman in October, 1986. Apparently, Secretary Lehman felt that individual organizations were capable of performing their own Efficiency Reviews to arrive at Most-Efficient-Organizations. Also, while the Manpower Engineering Centers were still going concerns, the EFDs were exempted from undergoing Efficiency Reviews and development of a Divisional staffing standard, *precisely* because of the scenario just described for 05. Does this type "complication" render useless the performance of an ER or negate the possibility of developing a staffing standard for these EFD Divisions, or any other organization that is service-oriented instead of production-oriented? Absolutely not. Two examples will be cited.

In 1983 the Naval Postgraduate School Public Works Department (PWD) came under study for the Commercial Activities Program. They were told to develop and implement a MEO and then compete in the civilian marketplace to perform public-works services at NPS. Going through a process similar to what has been outlined, they cut their work force by 30%, primarily by changing from a trades-structured organization, i.e., carpentry shop, electrical shop, etc., to a functional organization, i.e., teams to perform trouble calls, standing job orders, etc. As a result, Public Works' bid was $400,000 less than a local contractor's, and personnel at the PWD retained their jobs. Additionally, a SHORSTAMPS staffing-standard equation was developed using MEO labor input data.

Northern Division recently completed a similar management review initiated to cope with a reduction in staffing and a desire to provide improved services. There, measures were a bit more drastic as they shifted an entire division from the cognizance of one department to another. The results, though, have been the same: a reduction in staffing while maintaining previous levels of service.

Several of the EFDs have found ways to address the problems of developing staffing standards for their Divisions by using innovative derivatives of the methods described here. These will be described in Chapter IV.

H. CHAPTER SUMMARY

The average manager might dismiss the methods discussed in this last chapter as pie-in-the-sky. Who manages by statistics anyway? This attitude may not comfort the Program IV managers who must allocate resources among their Divisions. Another consideration is the resource budgeting system NAVFAC used for the first time in FY 87. Previously, resource allocations to the EFDs were "fenced" by Program. Although the EFD commanders had some latitude in redistributing these resources among Programs, this latitude was limited. In FY 87 NAVFAC allocated resources to the EFDs in one lump sum, leaving it to the EFD commanders to allocate resources among Programs. This task can be quite intimidating. Personal judgment (seat of the pants) alone will not suffice.

In summary, it is apparent that the "best" means of manpower demand forecasting is a combination of quantitative and subjective methods. As the type of the forecast changes from determining work center requirements to determining requirements of an entire command structure, the quantitative and subjective emphases will change and certain methods may no longer apply, but the general nature of manpower forecasting remains remarkably constant.

IV. EVALUATION OF NAVFAC'S CURRENT MANPOWER STAFFING SYSTEM

Everything should be made as simple as possible, but not more so.-- Albert Einstein

This chapter brings together information provided in the first three Chapters to evaluate NAVFAC's manpower staffing system for the facilities acquisition mission. This system has three primary tiers: budgeting at the POM level, distributing the manpower resources obtained by NAVFAC from Congress/CNO among the EFDs, and, at the EFD level, distributing Programs IV & IX resources among Divisions (02, 04, 05, 09A2, 09A1, etc.). Because the NAVFAC facilities acquisition process embodied in Programs IV and IX use nearly 60% of NAVFAC's manpower resources, a separate and distinct system is used by NAVFAC in forecasting requirements for this mission. This is in contrast to the remaining NAVFAC/EFD Programs which do not each have a separate forecasting system at the NAVFAC level. This chapter traces the development of the POM-level staffing system for the acquisition mission. The validity of this system is evaluated considering the not only the complexities outlined in previous chapters, but also comments received from the EFDs, comparison with generally accepted methods of manpower demand forecasting, comparison with forecasting methods used by the Army Corps of Engineers, and results of a statistical analysis using current data. This chapter continues with a similar evaluation of the methods NAVFAC uses to allocate resources among EFDs. Recommendations for improvements will be made in the final chapter.

A. DEVELOPMENT HISTORY OF NAVFAC MANPOWER FORECASTING SYSTEM

Until 1980, NAVFAC's method of manpower forecasting was very simplistic, and it could afford to be. As stated in Chapter II, NAVFAC's WIP efforts can be divided into two types: income-bearing WIP and non-income-bearing WIP. Prior to the mid 1970's NAVFAC's construction efforts were almost entirely income bearing WIP. In FY 71 non-income bearing O&M funded RPM and Facility Support contracting WIP accounted for less than five percent of total WIP, while MILCON WIP accounted for more than 60%.[11] Thus, to budget for manpower, NAVFAC simply estimated the amount of SIOH dollars to be collected from their income bearing WIP (see Chapter II, section D.1. to become reacquainted with SIOH), and, based on overall average labor cost per work-year, translated this to required numbers of people. The system generally worked well because the majority of project workload was MILCON, and thus the dollar value of the project reflected (within reasonable accuracy) the overall relative labor effort required to administer the contract (i.e. a $2 million project required twice as much effort as a $1 million project). Thus, if WESTDIV were projected to perform twice as much WIP as NORTHDIV, they were allocated twice as many Program IV work-years (there was virtually no such thing as Program IX WIP because Facility Support Contracts were still in their infancy). However, from 1974 to 1980 non-income-bearing WIP jumped from 6 percent of total WIP to more than 20%, and in 1985 it comprised 30% of total WIP.[12] A similar increase was experienced in the numbers of these projects. Additionally, non-income-bearing WIP was not spread evenly among EFDs for each year. Thus, the unique character (mixture of types of WIP) of each EFD's workload was not reflected in total WIP, the levels of which had been used as the guide for manpower budgeting. The consequences of this shift in WIP composition were that SIOH fees from income-bearing WIP, which previously had been able to subsidize the administration of non-income bearing WIP, were no longer able to do so. Additionally, the EFDs which bore the brunt of this increase in non-income bearing WIP were becoming severly understaffed in relation to "true" workload. As LT Greg Parker so astutely recognized in his 1976 thesis, which evaluated the Navy's facility acquisition process and briefly addressed staffing procedures:

---

[11] Source: FACSO reports on WIP

> In addition, resources tend to be allocated strictly on the basis of relative changes in program levels (dollar) and not on the basis of the specific requirements of each project. As such, the differences in the unique character of each EFD's workload are not being fully recognized. As a result each EFD's capabilities and commitments to meet the current set of program goals vary. [Ref. 22: p. 65]

In short, NAVFAC needed a new manpower budgeting system not only at the POM level, but also to determine allocations among EFDs.

In 1980, NAVFAC in conjunction with the Navy Manpower and Material Analysis Center (NAVMAC) developed a POM-level manpower staffing standard for the facilities acquisition mission. Much of the thrust of their efforts went into determining Workload Factors, which are those factors (discussed in Chapter III) that have a causal effect on manpower staffing. As stated by Mike Galgano, one of the developers of the staffing standard:

---

[12] Source: FACSO

> The ideal situation would be the capacity of measuring each individual's time against each facility and contract. The practicality of such an exercise is futile at best. This type of effort would more than likely take a disproportionate share of the work force's time (author's note: a forecasting system must be cost effective--Chapter III). Consequently, a search for viable parameters that would relate closely to an actual individual's work effort was necessary. Therefore, a "model" was established utilizing available work quantifications. [Ref. 23: p. 2]

As stated in Chapter III, the criteria for a good manpower forecasting model, especially one that will be used to justify manpower budget requests at the Congressional level, are that it be credible, be significant, and be cost-effective. NAVFAC's intent was to develop such a model. Therefore it was seeking to use its most visible and measurable product--work-in-place--to use as a yardstick to determine its manpower requirements. However, as previously stated, "raw" WIP is not a good indicator of administration effort because, per dollar of WIP, different types of projects, particularly O&M funded RPM projects, are more numerous and thus more administration intensive, than others. Table 10 illustrates the differences in the number of contract awards by fund source for the CONUS EFDs for FY 86. In unitary terms, a dollar's worth of MILCON WIP may represent one project, while a dollar's worth of O&M work may represent ten projects, and it is far easier to administer one contract worth one dollar than ten contracts each worth ten cents. The solution sought was to *weight* the WIP by fund type to incorporate the influence of relative numbers of projects and to reflect relative administrative effort required to accomplish facility acquisition.

The result of NAVFAC's research gave rise to three workload parameters that were not only measurable, but *measurable by fund source*: (1) Active contract workdays; (2) Number of active contracts; and (3) Number of active projects. The definition of these parameters are:

1. **Active Contract Workdays** are the total number of calendar days between the contract award date and the Beneficial Occupancy Date.
2. **Active Contracts** are any awarded contracts that has active contract workdays during the period considered.
3. **Active Project** is a line item or project whose primary procurement document either qualifies as an active contract or is in the process of becoming an active contract (i.e. between design authorization and contract award).

TABLE 10

CONTRACT AWARDS BY FUND SOURCE, FY 86

Fund Source	No. of Awards	Fund Source	No. of Awards
MILCON	275	FAC 0%	2055
NIF	1548	FAC 3%	1190
FH	599	RIM	32
RPM	5427	ODC	193

Source: CMS data base

NAVFAC then attempted to relate "effort" to these parameters, and in doing so made several assumptions. The first assumption was that *contract workdays* served as a yardstick to measure the EFD field-type (ROICC) effort of inspection and construction management. The rationale for this assumption was that effort required by both the facility itself and its related contract administration normally occurs throughout the active life of the contract. The larger and/or more complex the facility, the more contract days involved, indicating more effort, while the reverse is true for smaller items. [Ref. 23: p. 2]

The second assumption was that since effort related to contract services is directly connected with contract-procurement functions, the EFD field and headquarters efforts supporting this area (Contracts Division personnel at headquarters and at OICC/ROICC Offices) could be measured as a function of the volume of *active contracts* [Ref. 23: p. 3]. In an interview with Mr. Galgano, the question was raised as to why the *number of contracts awarded* was not a better measure of Contracts Division effort, since *active contracts* could include contracts awarded in previous fiscal years. According to Mr. Galgano, *active contracts* was a better and more realistic measure of effort because the Contracts Division expends effort on a contract throughout its duration, not just during award. This point was emphasized in section II.C.1.d. of this thesis.

Finally, the Project Manager's functions (09A2 or 50) concentrate on overall projects and phase coordination. The EFD Project Management effort could be measured by ***number of projects*** that this functional area handled and to what degree these efforts were devoted to the various phases of individual projects [Ref. 23: p. 3]. *Number of projects* differs from *number of contracts* in that a project, such as construction of an airfield, can include several contracts, such as construction of the runway, or construction of the control tower.

By using these three parameters to develop weighted WIP factors it was determined that, "within an acceptable degree of error," *fund source* of WIP was an accurate predictor of administration effort, and thus dollar amounts of WIP weighted by fund source, in regression analysis, contribute to a staffing standard or model to forecast resource requirements (the dependent variable) for the acquisition mission. [Ref. 24]

The question arises as to the validity of the assumption that weighted WIP is the best workload factor to predict manpower requirements. Two avenues are explored in answering this question. The first is a comparison with the method used by the Army Corps of Engineers. The second draws upon manpower staffing theory discussed in the previous chapter.

Although a more in-depth discussion of the Army Corps of Engineers (ACE) recently developed manpower staffing standard follows later in this Chapter, it is appropriate to address their findings on this matter. ACE embarked on a completely independent study in 1985 to develop a staffing standard for their acquisition mission for much the same reasons NAVFAC did in 1979: The nature of their WIP had changed from primarily MILCON to a more evenly dispersed mixture of WIP fund sources, and their former system of manpower budgeting by SIOH rates was no longer adequate. In a preliminary study ACE attempted to relate administration effort to a project's facility category code.[13] Thus, by knowing the category codes of projects to be constructed during the upcoming year, the administration effort (work-years) required for each category code, based on historical data, could be summed over all the projects, thus arriving at a total manpower requirement. An example illustrates the reasoning: The acquisition of communications facilities, one category code, is more complex to administer than, say, warehouses, another category code, because, for the communications facilities, there is less margin for error in workmanship resulting in more thorough inspection efforts by ROICC, and the design process must be more exact, resulting in greater oversight efforts by the Design Division. If, somehow, the relative value of administration effort per category code could be determined, this would be an ideal workload factor.

---

[13] Each shore facility has a four-digit category code identifier, with classes of buildings such as warehouses, administration buildings, hospitals, etc. having the same first-two numbers.

There were, however, major drawbacks to this method that precluded its use. For one, data base records were not substantial enough to accurately assign relative weights of difficulty by category code. Secondly, nearly 60% of ACE workload (like NAVFAC's) was non-MILCON, and the category codes of these future projects was almost completely unpredictable. What *was* predictable, and determined to be sufficiently accurate to discriminate relative effort, was WIP fund source, and this is used as a workload indicator in the new ACE forecasting model. In a sense, then, NAVFAC's original decision to use project fund source as a relative measure of effort was seconded by ACE in a separate study six years later. [Ref. 25]

From a textbook point-of-view, using WIP weighted by fund source follows established macro-level forecasting methods. The most accurate method is to use multiple regression analysis to arrive at a staffing standard, using several workload variables as predictors of labor requirements. To arrive at weighted WIP factors, several other primary workload factors are involved, such as number of projects, and duration of projects. In the true sense, then, by using weighted WIP, more than one variable is being used to forecast manpower requirements.

In developing NAVFAC's staffing standard in 1980, which is used today, two major data criteria decisions were made. Firstly, NAVFAC used only six months' worth of data--the first half of FY 79--to develop their weighted factors. The reasoning behind this decision was:

> The parameters selected must be measured over a finite time period that contains the best and most current quantifiable information available. The timeframe encompassed by 01 October 78 and 31 March 79 was selected because:
>
> - Prior fiscal years are purged of completed locally accepted and station awarded workload. Hence, the Construction Management System (CMS) would not provide a meaningful measurement of workload parameters.
> - By the end of the second quarter, support costs begin to level off in relation to both labor and total costs. Furthermore, for analytical purposes and comparisons, conclusions from such an analysis can be straight-lined to draw final year conclusion that will be within tolerable accuracy.
> - The duration is sufficient to absorb any workload irregularities in arriving at a "typical" workload picture.

- The period contains the most accurate measurements of work efforts and costs that depict current performance levels. [Ref. 23: pp. 4-5]

The second criteria decision was that the model would be used to develop a staffing standard for all Acquisition Organization Divisions *except* the Design Division, Code 04. The reasoning was that this model would only assess efforts for construction management and administration, not design. Later, however, after the weighted WIP values had been developed as workload factors, regression analysis showed that these were accurate predictors of 04 requirements as well as the construction management and administration requirements, and thus 04 was incorporated in the final SHORSTAMPS model. [Ref. 26]

The reader may have already recognized a potentially significant "problem" with the first criteria decision: Data from only one fiscal year was used in developing this standard. Addressing this decision, there is the obvious questioning of the representation of just one year's data. The NAVFAC acquisition process and the types of work that NAVFAC performs have undergone significant changes since 1979. The contracting process has become much more deliberate. More stringent contracting regulations are in effect, more thorough contract documentation is required, and an increase in the frequency of management inspections of contracting offices has occurred. The types of work that NAVFAC performs in the area of facilities acquisition now includes a greater proportion of Facilities Support Contracts, which are very labor intensive to administer. Additionally, the EFDs have been "down loading" most of the O&M work to field PWCs, PWDs and ROICCs. As stated in a NAVFAC report:

> At one time the typical ROICC's only role was to administer construction contracts which had been awarded by the EFD. One procurement clerk (1106) was normally the only "contract expertise" needed. Policy changes in recent years have resulted in more complex contracting requirements and more diversified areas. The typical ROICC Office now is also an OICC and is involved with awarding Title II, facilities support, A-E, and new construction within its local authority. Accordingly, the role of the EFD has changed from principally execution to that of providing substantial oversight to subordinate contracting units. [Ref. 27: p. 3]

In short, EFD overall mission responsibilities today may be the same as in 1979, but the way they are carried out has changed significantly, along with changes in EFD organization. Consider that in FY 79 one labor hour of EFD Program IV effort yielded

$500 in WIP, while in FY 86 one labor hour of effort resulted in $375 WIP (constant FY 79 $).[14] The question to be addressed in this section is: How valid is NAVFAC's POM-level staffing model, developed in 1980, *and having undergone no updates since*, for use in 1987 and beyond? This question will be partially answered by recreating the statistical analyses done in 1979 to obtain weighted WIP factors, and by using FY 85 and FY 86 data from the four CONUS EFDs.

B. METHODOLOGY

This section traces the methodology NAVFAC used in deriving weighted WIP factors from the three parameters of *active contracts, active contract workdays, and active projects*. Data from FY 85 and FY 86 are used here to derive **updated** weighted WIP factors. These will be compared to those derived in 1980 using FY 79 data. Sources for FY 85 and FY 86 data included NAVFAC's Integrated Program Management System (IPMS) and Construction Management System (CMS) data bases. Three computer programs were written to access specific information from these data bases. The first provided Programs IV and IX labor hours and labor costs broken down by three-character cost-account code and by work-center (02, 04, 05, etc.). Figure 4.1 shows the construction-program cost accounts. The next program yielded, by WIP fund group for each EFD, the number of active contracts during the fiscal year and number of active contract days. The final program provided WIP by fund source for each EFD.

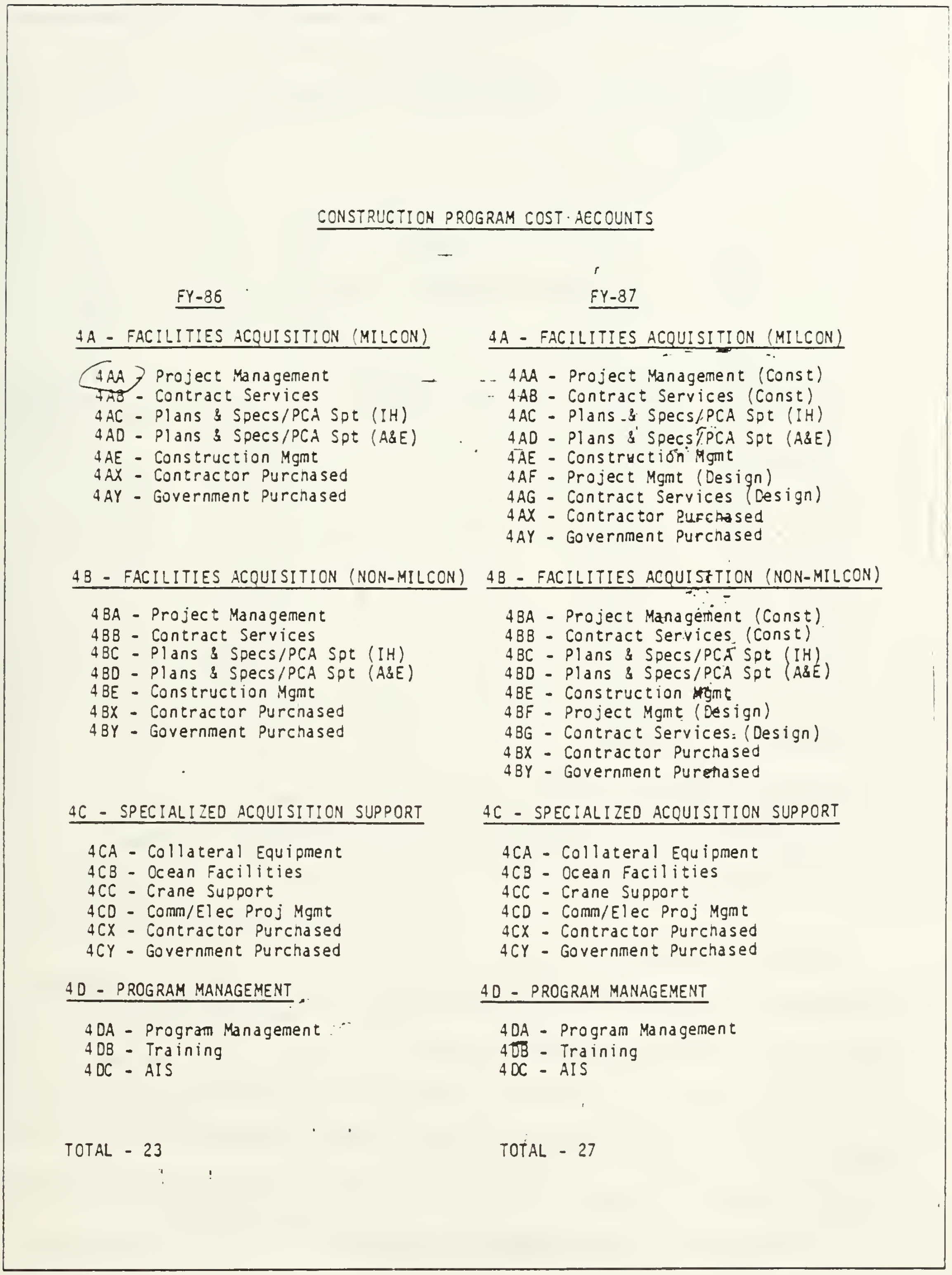
To derive weighted WIP factors a three step process was followed:

1. Labor hours were divided into five categories: (1) 05 field construction management and inspection hours; (2) 02 field-contract service costs; (3) 05 headquarters costs; (4) 02 headquarters costs; and (5) 09A2/09A1/50 headquarters costs.
2. These hours were related to fund source using the parameters of number of active contracts and contract workdays. The actual process is too lengthy to describe here. Reference 23 pages 8-13 outlines the process.
3. Total WIP per fund source was divided by total man-hours per fund source to obtain weighted WIP factors. Tables 11-16 summarize these results in tabular form.

Note that the parameters in Table 11 are divided into two percentage columns: a **total percentage** column, which represents the percentage of active contracts or active days for a particular fund source based on all eight WIP categories, and a **non-MILCON** percentage column, which represents the percentage of that fund source based only on non-MILCON fund sources. This was done because while the cost

---

[14] Source: NAVFAC CMS and IPMS data bases



CONSTRUCTION PROGRAM COST ACCOUNTS

FY-86	FY-87
4A - FACILITIES ACQUISITION (MILCON)	**4A - FACILITIES ACQUISITION (MILCON)**
4AA - Project Management	4AA - Project Management (Const)
4AB - Contract Services	4AB - Contract Services (Const)
4AC - Plans & Specs/PCA Spt (IH)	4AC - Plans & Specs/PCA Spt (IH)
4AD - Plans & Specs/PCA Spt (A&E)	4AD - Plans & Specs/PCA Spt (A&E)
4AE - Construction Mgmt	4AE - Construction Mgmt
4AX - Contractor Purchased	4AF - Project Mgmt (Design)
4AY - Government Purchased	4AG - Contract Services (Design)
	4AX - Contractor Purchased
	4AY - Government Purchased
4B - FACILITIES ACQUISITION (NON-MILCON)	**4B - FACILITIES ACQUISITION (NON-MILCON)**
4BA - Project Management	4BA - Project Management (Const)
4BB - Contract Services	4BB - Contract Services (Const)
4BC - Plans & Specs/PCA Spt (IH)	4BC - Plans & Specs/PCA Spt (IH)
4BD - Plans & Specs/PCA Spt (A&E)	4BD - Plans & Specs/PCA Spt (A&E)
4BE - Construction Mgmt	4BE - Construction Mgmt
4BX - Contractor Purchased	4BF - Project Mgmt (Design)
4BY - Government Purchased	4BG - Contract Services (Design)
	4BX - Contractor Purchased
	4BY - Government Purchased
4C - SPECIALIZED ACQUISITION SUPPORT	**4C - SPECIALIZED ACQUISITION SUPPORT**
4CA - Collateral Equipment	4CA - Collateral Equipment
4CB - Ocean Facilities	4CB - Ocean Facilities
4CC - Crane Support	4CC - Crane Support
4CD - Comm/Elec Proj Mgmt	4CD - Comm/Elec Proj Mgmt
4CX - Contractor Purchased	4CX - Contractor Purchased
4CY - Government Purchased	4CY - Government Purchased
4D - PROGRAM MANAGEMENT	**4D - PROGRAM MANAGEMENT**
4DA - Program Management	4DA - Program Management
4DB - Training	4DB - Training
4DC - AIS	4DC - AIS
TOTAL - 23	TOTAL - 27

Figure 4.1 NAVFAC Cost Account Codes

account codes delineate between MILCON and non-MILCON fund sources for most cost accounts, they do not for the Program Management cost account. Thus, the percentage total column was used to allocate resources from this cost account to all WIP fund sources.

TABLE 11

CONTRACT PARAMETERS FY 85 & FY 86, CONUS EFDS

Fund Type	No. Active Contr.	%Tot	Percent Non-Milcon Tot	#Days (000)	%Tot	Percent Non-Milcon ToT
MILCON	1786	5		248.4	9.3	
NIF	5881	16.3	17.1	503.9	18.8	21
FH	1625	4.5	4.7	90.0	3.3	4.0
ODC	1194	3.3	3.4	93.1	3.5	4.1
RIM	405	1.1	1.2	44.2	1.7	2.0
RPM	16189	44.8	47.2	932.4	34.8	38.0
FAC 0%	5419	15	15.8	439.4	16.4	18.0
FAC 3%	3642	10	10.6	327.8	12.2	13.0

Source: NAVFAC IPMS and CMS data bases

See pages 66-67 for explanation of fund source

In Table 13 the FAC 0% workload factor (WLF) was selected as the base in the development of the other WL equivalent factors or weighted WIP factors. Analysis indicates one man-hour generates different workload factor values by different appropriation groups, i. e., one man-hour in FAC 0% efforts produces $393.80 of FAC 0% WIP, while one man-hour in MILCON efforts generates $571.80 in WIP. To reflect the disparities, the FAC 0% workload factor was selected as the base and the others were weighted against it. These values are shown in column D.

1. Development of Staffing Standard Equation

In developing WL equivalent factors in 1980 NAVFAC used only the labor hour data for codes 05, 02, and the Project Management Division. NAVFAC then

TABLE 12

FY 85/86 EFD WIP BY FUND SOURCE (CONSTANT FY 79 $, MIL)

	Engineering Field Division			
Fund Source	ND	CD	SD	WD
RPM	70.9	42.4	142	205
NIF	75.5	35.3	16.8	61
FH	27.3	11.6	11.7	135
ODC	32.5	18.5	18.3	31.3
RIM	19.4	15.6	10.0	65
MILCON	134	94	250	438
FAC 0%	26.7	21.7	63.3	69.8
FAC 3%	36.9	21.8	5.8	56.8
Tot	423	260.9	517	1061

Source: FACSO

developed a regression equation using NAVFAC's total weighted WIP per month for FY 79 (excluding OICC Trident) as the independent variable value and the *total* Acquisition Organization labor hours per month (including code 04) as the dependent variable value. The equation derived was:

$$Y = \{a(11{,}695) + 7.577(X/12)\}/145.136 \qquad \text{(eqn 4.1)}$$

- Y = Total Work-years required
- a = Number of EFDs in equation, i.e., for four EFDs, $a = 4$, for one EFD $a = 1$
- X = Total weighted WIP for EFDs, in thousands

X in equation 4.1 can also be expressed as follows:

$$1.0X_1 + .911X_2 + .321X_3 + .305X_4 + .182X_5 + .138X_6 + .131X_7 + .070X_8$$

- X_1 = Total RPM WIP, in thousands

TABLE 13

DEVELOPMENT OF UPDATED WEIGHTED WIP COEFFICIENTS

Fund Source	A Labor Hours (000)	B Total WIP ($, mil)	C Workload Factor Value Per Man-Hour ($/hr) B/A	D Workload Equiv. Factor or, Weighted WIP Coeff.
MILCON	1,600	915	571.8	.688
NIF	460	188.7	409.8	.96
FH	120.3	185.8	1544	.25
ODC	96.3	100	1038	.38
RPM	1,145	460.1	401.8	.98
RIM	42.3	109	2578	.15
FAC 0%	460.6	181.4	393.8	1.0
FAC 3%	339.3	135	397.9	.99

Source: NAVFAC CMS and IPMS data bases

WIP is total of FY 85 and FY 86 for CONUS EFDs, constant FY 79 $, mil

- X_2 = Total NIF WIP, in thousands
- X_3 = Total Family Housing (FH) WIP, in thousands
- X_4 = Total Other Direct Cost (ODC) WIP, in thousands
- X_5 = Total Reimbursable (RIM) WIP, in thousands
- X_6 = Total MILCON WIP, in thousands
- X_7 = Total Facility Support Contract 0% (FAC 0%) WIP, in thousands
- X_8 = Total Facility Support Contract 3% (FAC 3%) WIP, in thousands

The equation developed using updated data is:

$$Y = (220{,}289 + 3.28X)/(1741) \qquad \text{(eqn 4.2)}$$

- Y = Total work-years required for the four CONUS EFDs

TABLE 14

FY 85/86 CONUS EFD WEIGHTED WIP BY FUND SOURCE

Engineering Field Division WIP ($, mil)

Fund Source	ND	CD	SD	WD
RPM	468.1	40.7	136	197
NIF	72.5	33.9	16.1	58.5
FH	6.8	2.9	2.9	33.8
ODC	12.4	7.0	6.9	11.9
RIM	2.9	2.3	1.5	9.8
MILCON	91.2	64.7	172	301
FAC 0%	26.7	21.7	63.3	69.8
FAC 3%	36.4	21.4	5.7	56.2
Tot	317	194.7	404	738
Total Labor Hours				
	1,368K	853.4K	1,416K	2,664K
Weighted WIP per Labor Hour ($/hr)				
	231.8	228.2	285.2	277

Source: NAVFAC CMS data base

WIP in constant FY 79 $, mil, multiplied by WL equivalent factor of column D Table 13.

- X= Total weighted WIP, in thousands

X in equation 4.2 can also be expressed as follows:

$$0.98X_1 + .96X_2 + .25X_3 + .38X_4 + .15X_5 + .688X_6 + 1.0X_7 + .99X_8$$

Each of the X variables corresponds to those of equation 4.1

TABLE 15

COMPARISON WITH NAVFAC WIP FACTORS

Fund Source	NAVFAC Workload Factor ($/hr)	Updated Workload Factor ($/hr)	NAVFAC WL Equiv. Factor	Updated WL Equiv. Factor
MILCON	1479	571.8	.138	.688
NIF	249	409.8	.911	.96
FH	500	1544	.321	.25
ODC	541	1038	.305	.38
RIM	1687	2578	.182	.15
RPM	210	401.8	1.0	.98
FAC 0%	1290	393.8	.131	1.0
FAC 3%	4017	397.8	.070	.99

Source: NAVFAC CMS and IPMS data base

TABLE 16

EFD PROGRAMS IX & IV LABOR COST COMPARISON

EFD	FY 85/86 Labor Cost	WIP/Labor Cost
ND	$25,951,000	12.21
SD	$24,430,000	16.53
WD	$47,857,000	15.42
CD	$16,433,944	11.84

Source: NAVFAC CMS and IPMS data bases

Of importance in this thesis is the difference in the coefficients or weighted values for each of the fund-source variables, between NAVFAC's equation using FY 79 data and the equation developed in this thesis (4.2) using FY 85 and FY 86 data.

2. Assumptions

In developing Tables 11-16 several key assumptions were made. They are described together with the rationale as to why the assumption was made.

- WIP includes EFD WIP only. Excluded was WIP from PWC Great Lakes, PWC San Diego, and PWC Pensacola. This is in accordance with NAVFAC original methodology.
- Excluded from EFD Program IV labor hours are CHESDIV's Ocean Engineering Function, ROICC PAC at WESTDIV, and NORTHDIV's Weight Handling Group. Rationale is same as (1) above.
- Included in WESTDIV's labor hour totals are the OICC Navy Regional Medical Center, OICC Travis AFB, and the Pacific Northwest branch in Washington. These organizations were included because they were considered an extension of WESTDIV's Acquisition Organization and their WIP was included in WESTDIV's total.
- Information on **active projects** was not available. Thus, to distribute the Project Manager's labor hours among fund sources the parameter of **active contracts** was used. Interviews with NAVFAC personnel indicated that, within reasonable accuracy, active contracts was an acceptable substitute for active projects. Any errors were not considered significant because the Project Managers contributed less than 10% to the labor hour total for all EFDs.

C. INTERPRETATION OF DATA

Attention should be focused on Table 15 which compares WLF and WL equivalent factors developed by NAVFAC using FY 79 data and factors developed in this thesis using FY 85 and FY 86 data. There are significant differences, notably in the WL equivalent factors for MILCON, FAC 0%, and FAC 3%. This is not surprising. In FY 79 Facility Support Contracts were in the beginning of a transition stage, both in the volume of work represented by these type contracts, as well as the implementation procedures. Since FY 79 the percentage of overall WIP represented by these contracts has nearly doubled. Administration of these contracts has undergone significant changes to the extent that at each of the Public Works Centers an entire department is devoted to administration of these contracts. As recently as four years ago none of these departments existed.

The fact that the MILCON WL equivalent factor significantly changed was also not unanticipated. Consider that there has been a tremendous increase in 02 Division staffing since FY 79. This Division devotes most of its work to the MILCON area. Additionally, increased ROICC responsibilities in the areas of inspection and contracts administration have led to an increase in labor hours devoted to MILCON projects.

Before proceeding further it must be noted that WL equivalent factors (or weighted WIP factors) developed in this thesis are not considered to be *exact* factors because of assumptions made and interpretations of data. Similarly, the regression equation developed in this thesis for forecasting manpower requirements is not intended for ultimate use by NAVFAC. It is presented here simply to show that facilities acquisition has greatly changed since 1979, one year's data is not entirely representative of the entire process, and these changes are manifested in the changed manpower staffing factors. Further perusal of Table 16 reveals that every workload factor has changed since 1979, some increasing and some decreasing. Does this, then, invalidate NAVFAC's staffing-standard equation developed in 1980? Incredibly, and fortunately, no. Table 17 reveals why. This table shows the WIP composition by fund source for all NAVFAC EFDs from FY 79 to FY 86. Quite simply, fluctuations in WIP composition percentage have coincided with offsetting changes in the workload factors resulting in nearly a zero overall net change, meaning that NAVFAC's FY 79 staffing equation is still valid--so far. To validate this conclusion WIP for FY 85 - FY 86, using NAVFAC's original weighting factors, was inserted in NAVFAC's staffing-standard equation to determine how many work-years the EFDs should have used to accomplish that WIP, based on NAVFAC's equation. The results were that NAVFAC's equation predicted within 15% the number of work-years actually used.

TABLE 17
PERCENTAGE WIP BY FUND SOURCE

	Fiscal Year							
Fund Source	79	80	81	82	83	84	85	86
MILCON	43%	45%	32.4%	32%	40%	41%	42.7%	38.1%
FH	9.3	8.8	8.0	7.8	4.5	7.0	8.4	8.1
NIF	7.8	8.9	9.3	8.7	8.4	7.2	6.7	9.1
RIM	12.3	9.7	11.3	11.6	6.7	4.6	4.2	5.2
RPM	16.2	17.5	21.5	20.3	21.0	21.5	20.8	20.0
FAC 0%	4.4	3.5	4.7	5	5.4	5.3	4.6	6.1
FAC 3%	3.5	4.3	7.0	7.1	7.3	8.3	8.1	7.8

Source: FACSO
Note: There may be some rounding error

The skeptical reader might say two things of this result. Firstly, to predict within only 15% of actual manpower resources used does not imply good accuracy of a staffing equation. Secondly, the reader might exclaim, "Of course NAVFAC's equation predicts work-years used--it was this equation that was used to determine the number of work-years NAVFAC would be allocated from the POM process to begin with!"

Addressing the first statement. Any student of the Federal Budget process is well aware that what is asked for in the budget and what is actually received from Congress are not usually one and the same. So it is with manpower resources. Thus the 15% difference between staffing-standard projected manpower requirements and those actually used fairly well tells the tale of the budget process.

Of the second statement, it is not entirely an accurate one. NAVFAC was allocated work-year resources based on *projected* WIP. If NAVFAC was not receiving enough resources,then this shortfall would be reflected in the amount of WIP it could produce. In fact, NAVFAC is producing WIP at a volume commensurate with the work-years allocated from its 1980 staffing-standard equation. Of course, if there were some overall indicator of *quality*, it might be shown that the quality of facilities acquisition had declined and thus more personnel were needed to improve quality. As no such indicator exists, this argument cannot be supported.

1. The Need for Updated Weighted WIP Factors

The apparent fact that NAVFAC's 1980 staffing standard-equation is still valid does not mean there is any less of a need to provide an updated version. Workload projected is for an increase in MILCON as the Strategic Homeporting Program gets final approval from Congress and for an increase in Facility Support Contracts as the Commercial Activities Program gains further acceptance. These are the very WIP categories that have undervalued workload factor coefficients. Thus, under NAVFAC's current staffing system there could be a shortfall of manpower resources to handle NAVFAC's "true" workload. Revised workload factor equivalent coefficients are needed to more accurately portray NAVFAC's manpower requirements.

D. RESOURCE ALLOCATION TO THE EFDS

To allocate manpower resources to the EFDs NAVFAC uses, as its primary base, the SHORSTAMPS staffing-standard equation. This section will evaluate the validity of using the SHORSTAMPS model in view of the numerous complexities of the staffing process outlined in Chapter II, as well as the results of the previous section of this chapter.

Before proceeding, some statistical insights will be provided. Manipulating the statistics of Table 14 shows that NORTHDIV used 4.31 labor hours for each $1000 WIP, CHESDIV 4.38 labor hours for each $1000 WIP, and SOUTHDIV and WESTDIV 3.5 and 3.6 respectively, or nearly a 20% difference. In view of the new Managing to Payroll program, Table 16 is particularly revealing. Per labor dollar, SOUTHDIV and WESTDIV were able to place significantly more WIP than NORTHDIV and CHESDIV.

Chapter II raised the point that statistical analysis enables judgment to focus on that aspect of a problem that should be reserved for judgment. In view of the numerous complexities affecting manpower staffing, what percentage of an EFD's requirements can be determined by NAVFAC's staffing model and what percentage must be reserved for judgment by the NAVFAC CAB and Program Managers? Before proceeding with this analysis, an interesting note must be mentioned. *Every* EFD Program manager interviewed indicated he was short in manpower resources. By how much they could not precisely say, but they were short. Interviews with NAVFAC Budget Analysts, however, revealed their thinking was that some of the EFDs were *overstaffed.* Certainly an interesting dilemma.

The Logistics Management Institute (LMI), under contract to the Army Corps of Engineers (ACE), sought to tackle the question of to what degree is a staffing equation alone an adequate predictor of resource requirements for the ACE District Organizations? For ACE Districts any staffing complexities would be more pronounced than for NAVFAC's EFDs because there are more than 25 ACE Districts worldwide. In the case of NAVFAC's six EFDs, complexities would tend to be "smoothed out" simply because of the sheer size of each EFD. ACE District organizations vary distinctly in size, geographical areas served, visibility of projects, etc. LMI demonstrated that their newly developed staffing equation alone was an accurate predictor of 80% of each District's manpower requirements. ACE then convened a workshop in which representatives from every District were provided the forum to voice every factor they felt made their District unique and thus deserving of special consideration in the staffing process. These factors totaled more than 50. Then, using *Decision Support* software, ACE narrowed these factors (which included workload in terms of WIP), to less than ten, and each factor was weighted with respect to its influence on staffing. As stated in Chapter II, LMI is attempting to quantify important staffing complexities in order to develop a single equation or staffing model to forecast as close to 100% of District staffing requirements as possible. The purpose of the ACE workshop was to focus on the most important factors on which to collect data. [Ref. 25]

The results of this workshop, of importance to this thesis, are that the District representatives confirmed through an interactive problem-solving process that *workload alone* accounts for approximately 80% of staffing requirements, essentially validating LMI's initial statistical analysis. The factors determined to most influence the remaining 20% of staffing requirements included geographic considerations such as CONUS or OCONUS location, number and dispersion of field offices, visibility of projects and of areas served, stability of projects (discussed in Chapter II, section C.3), and personnel turnover. These are virtually the same factors determined from interviews with NAVFAC EFD personnel. [Ref. 25]

1. Validity of SHORSTAMPS Model in Staffing EFDs

As shown earlier in this chapter, the SHORSTAMPS model needs improvement to accurately portray workload-equivalent factors for MILCON and Facility Support contracts. Given that a staffing equation predicts approximately 80% of manpower requirements (if not more for the EFDs), these differences in WL equivalent factor values could cause a shortfall in manpower staffing given a particular mixture of WIP fund types. Referring to Table 18, for FY 85 and FY 86, SOUTHDIV and WESTDIV, which had the lowest work-year to WIP ratios, also had the highest volume of MILCON and Facility Support WIP.

An interesting exercise is performed in Table 19 which shows man hour resources for FY 85/86 redistributed among EFDs under the updated staffing equation presented in this thesis. As shown, SOUTHDIV would gain more resources while weighted WIP-to-man-hour ratios converge closer than by using the existing SHORSTAMPS equation.

Several explanations account for the remaining differences of WIP-to-man-hour ratios. The experience level of the personnel at SOUTHDIV, an aspect repeatedly emphasized in interviews, may well account for that EFD being able to accomplish greater WIP with fewer personnel resources than CHESDIV and NORTHDIV. CHESDIV, which has the smallest EFD (less economy of scale than the other EFDs), the highest visibility of projects (requiring more personnel to administer), as well as a

TABLE 18
PERCENTAGE WIP BY FUND SOURCE BY EFD

	Engineering Field Division							
	ND		CD		SD		WD	
	Fiscal Year							
Fund Source	85	86	85	86	85	86	85	86
RPM	18	15.6	15.5	16.9	23.3	29.8	19	19.4
NIF	16.4	19	13.8	13	3.5	2.8	6	5.5
FH	8.1	4.8	7.0	1.9	2.7	1.7	14	11.8
ODC	6.2	9.1	1.0	12.9	4.2	2.8	2	3.5
RIM	4.5	4.5	7.8	4.2	1.0	2.3	9	3.1
MILCON	32	31	40.8	30.9	50.0	44.8	38	45.5
FAC 0%	7.0	5.6	7.8	8.7	12.6	11.4	7	5.9
FAC 3%	7.4	10	6.6	9.9	2.4	4.1	6	4.9

Source: CMS
Note: There may be some rounding error

higher personnel turnover rate than SOUTHDIV or NORTHDIV, requires more personnel per WIP than any other EFD, and these may well be the explaining factors. The question then arises as to why WESTDIV is *able* to accomplish more WIP per labor hour, or is *required* to accomplish more WIP per labor hour. This is, essentially, the same question that prompted this thesis and was depicted, in a slightly different form, in Table 1. Now, however, it is seen that the anomaly depicted in Table 1 is, in reality, not nearly as pronounced. In fact, using NAVFAC weighted WIP factors, NORTHDIV and SOUTHDIV for FY 85/86 had a combined work-year-to-weighted WIP ratio of 4.05 while WESTDIV's was 3.82. Using updated weighted WIP factors, this ratio was 2.22 for NORTHDIV and SOUTHDIV and 2.08 for WESTDIV. Thus, the 20% differential depicted in Table 1 is, more realistically, a 6% difference. However, given the strong influences on WESTDIV of such factors as high personnel turnover rate, dispersion of offices, potential diseconomy of scale, and demographics of

TABLE 19

REDISTRIBUTED LABOR HOURS BASED ON NEW STAFFING EQUATION

	Engineering Field Division			
	ND	CD	SD	WD
	Labor Hours (000)			
Actual	1,376.7	853.4	1,416.2	2,664.4
Redist.	1,260	858	1,545	2,640
	WIP-to-Labor Hour Ratios ($/hr)			
WTD WIP per Labor Hour (actual)	231.8	228.2	285.2	277
WTD WIP per Labor Hour (redist)	251.8	226.7	261.5	279.5

areas served, this six percent differential in relative staffing level in "favor" of WESTDIV should possibly be reversed.

The summary of this subsection is that NAVFAC's SHORSTAMPS staffing-standard equation in not nearly as accurate as a stand-alone method of allocating resources among EFDs as it is in determining NAVFAC-wide requirments. The percentage of WIP by fund source varies from EFD to EFD and this influences EFD staffing requirements. Updating the weighted WIP factors is probably more important for allocating resources among EFDs than for determining NAVFAC's requirements as a whole.

2. Influences of "Complexities" on EFD Staffing

The previous subsection briefly discussed the factors other than workload that have the greatest effect on EFD staffing. Several of these factors may explain why CHESDIV has a lower WIP/WY ratio than any other EFD and why SOUTHDIV has the highest. Of those primary influences identified during the ACE workshop, CONUS/OCONUS locations are not a consideration in this thesis and project stability was described in Chapter II as an occurrence that may equally effect each EFD. As statistics on stability were not available for each EFD, this influence is difficult to quantify. Of the other major factors such as "visibility," economy of scale, dispersion of field offices, turnover of personnel, etc., each EFD could claim one or more of these factors as unique. Resources were simply not available for this author to further investigate and attempt to quantify the effect of these factors on each EFD's staffing requirements. Chapter II section D.1 does describe these factors and suggests their general effects on staffing. However, **this observation will be made.** Interviews with senior NAVFAC personnel generally indicated that they were not completely aware of, or not using as the basis of judgment, many of the factors outlined in Chapter II. A recommendation in this area will be presented in the concluding chapter.

E. ALLOCATING RESOURCES AMONG DIVISIONS

Interviews with EFD Division Directors on staffing methods yielded both encouraging and disappointing results. One Division Director stated that he had no idea how personnel resources were allocated to his Division. Consider the following excerpt from the report "Organization and Staffing of NAVFACENGCOM Contracting Offices:"

> Third, the supervisors in the 02 organization are almost always so caught up in the crush of daily business that they defer, or fail to address altogether, the desired staffing and skill levels needed to do a truly adequate job. ("When you're fighting off alligators, you forget that your original goal was to drain the swamp.") What actually happens is that the typical 02 operates with a given staffing level indefinitely until the workload increases to an intolerable volume, at which time the 02 goes to the 09A and pleads for another body or two. [Ref. 27: p. 5]

The intent of this section is not to precisely define methods for each EFD Acquisition Organization Division to determine its manpower requirements. General methods were outlined in Chapter III, and specific methods are really potential subjects for future theses. However, it is recognized that the task confronting the head of an EFD Acquisition Organization is not an easy one when making decisions on allocating resources among his Divisions. Therefore, some guidance will be provided here.

A major theme of Division-level budgeting is that it tends to be incremental. Previous years' Division staffing levels will more than likely not be reduced. Consider that the overall trend in Acquisition Organization staffing has been an increase every year for the past six years (the length of time covered in this research). Therefore, in allocating these incremental resources it is generally a matter of assessing incremental increases in Divisional workload. Nothing fancy. Just a general projection of how much more workload will be done this year than was done last year. If Division X is projecting a 10% increase in workload and Division Y only a 2% increase, then the job of the Acquisition Organization Head in allocating those incremental resources is made that much easier. **Unfortunately, most Division Directors interviewed did not completely recognize this situation.**

NORTHERN Division had the most unique and innovative means of determining staffing levels for their 05 Division ROICC offices. Their system will briefly be described here primarily as an example of the concept of using an increase in relative workload to determine resource allocation.

NORTHDIV divided its field (ROICC) office workload into two primary categories: procurement efforts dealing with the contracts administration workload, and administration effort dealing with construction management. For each ROICC office points were given for total procurement effort based on numbers and types of contracts awarded, and administration effort based on numbers and sizes (dollar values) of active construction contracts. Points were then totaled for each office. The "best" office was then selected for use as the benchmark office. This office was judged the most properly staffed for its workload by the EFD headquarters staff. All other offices were then staffed based on their total points compared to the benchmark office. For example, if the benchmark office had 100 workload effort points and was staffed with 10 people, then if another office was projecting 150 workload points they would be staffed with 15 people. Similarly, relative changes in Divisional workload could easily be translated into changes in manpower requirements. For example, workload effort points summed for the entire division projected for the upcoming year could be compared to those for the previous year, and thus justification would exist for incremental staffing changes. The system is simple, but it enables management to make informed decisions on manpower staffing. [Ref. 28]

The quote at the beginning of this chapter by Albert Einstein highlights the manpower budgeting process at the Divisional level. As described in Chapter III, managers should aim for manpower forecasting systems that are credible, significant, and cost-effective.

F. CHAPTER SUMMARY

This chapter has addressed the significant aspects of NAVFAC's three tiered manpower demand forecasting system. The POM-level system is ideal in methodology. However, the need for updating the weighted WIP coefficients must be recognized.

The same SHORSTAMPS staffing model can be accurately used in allocating resources among EFDs. Judgment on the part of NAVFAC Program managers in interpreting outside staffing factors plays an important role in supplementing statistical analysis for allocating resources among the EFDs. Improved accuracy of the SHORSTAMPS model is possible by using more recent data. Similarly, Program managers must keep abreast of the outside factors that influence staffing in order to make accurate judgments.

At the Division level the simplest means of expressing relative changes in workload is the best management tool available to facilitate manpower forecasting.

V. CONCLUSIONS, RECOMMENDATIONS AND AREAS OF FURTHER STUDY

This thesis has sought to both portray the importance of manpower demand forecasting for the Naval Facilities Engineering Command and the difficulties and complicating factors affecting the determination of staffing requirements, as well as to provide methods by which forecasts can be made. Three primary conclusions are presented as a result of this research.

Firstly, the method by which NAVFAC forecasts staffing requirements at the POM level is considered valid. However, because a data base of only one year was used for developing the staffing model, the accuracy of the model can be improved by using more recent data over a period of several fiscal years. In this thesis, analysis has shown that at least three of the regression coefficients in the SHORSTAMPS model have changed significantly since the model's development.

At the second tier of NAVFAC's manpower budgeting system--allocation of resources among the EFDs--research by the Army Corps of Engineers has shown that a staffing-standard equation or model can be used to forecast approximately 80% of an EFD's requirements. The remaining staffing requirements are influenced by factors that are difficult to quantify and are best left for judgment decisions. These factors were described in detail in Chapter II. NAVFAC's SHORSTAMPS staffing-standard model, used with relative accuracy at the POM level, is subject to greater distortion at the EFD level because of differences in mixtures of WIP fund sources among the EFDs. The NAVFAC model still has a high degree of accuracy, but given the occurrence of particular changes in WIP-fund-source-mixtures, understaffing in relation to "true" workload could result. Updating the model's weighted WIP coefficients will result in enhanced manpower requirements forecasting accuracy.

The *general* influences of outside staffing factors was addressed in this thesis. Further research is necessary to properly weight these factors as to their effect on staffing requirements. Research indicated that many of the factors presented in this thesis were not adequately considered when resources were allocated among EFDs, because their effects, or their existence, were not known. It is recommended that NAVFAC convene a workshop similar to that done by ACE to specifically address and weight these factors. Given that there are only six EFDs, the scale of the workshop need be much smaller than that of the ACE workshop, which was attended by more thatn 25 District Officers.

This thesis also addressed the anomaly presented in Table 1 which apparently showed that WESTDIV was having to accomplish more WIP than NORTHDIV and SOUTHDIV combined, with 20% fewer personnel resources. In "real" terms this thesis shows there is only a five percent difference in staffing between the EFDs, thus allaying any major concerns about the adequacy of NAVFAC's manpower staffing system.

At the third tier of the budgeting system research indicated that methods by which an EFD Commander can base his decision to allocate resources among his Acquisition Organization Divisions can be improved. One such method was presented in this thesis. This is an area in which further research, specifically directed at determining staffing requirements for a single Division such as 04 or 02, could make an important contribution to NAVFAC management. The Contracts Division in particular lends itself to development of a staffing standard that could easily be used NAVFAC-wide. Research in the form of a thesis could perform an Efficiency Review and then develop a staffing-standard by performing a time study for each major element of workload.

Finally, a thesis might study the *costs* of understaffing. Chapter II addressed the absence of generally accepted indicators of *quality* and its effect on staffing. A thesis might attempt to quantify the costs of manpower shortage such as increased change orders (only two years' data was examined in this thesis, and then for only one Division), number of claims, polling customer satisfaction with a new facility, increased turnover of personnel caused by over-work, or other indicators. Accurate quantification of these costs would facilitate proper interpretation of Tables 16 and 19 and improve the staffing process.

LIST OF REFERENCES

1. Moore, W. B. and Salthouse, R. W., *Forecasting Corps of Engineers Military Construction Manpower Requirements: A Prototype Model,* unpublished report, Logistics Management Institute, Bethesda, Maryland, August 1986.

2. Fantzreb, R. B., "Human Resource Planning: Forecasting Manpower Needs," *Personnel Journal*, pp. 850-857, November 1981.

3. Werther, W. B., Jr. and Davis, K., *Personnel Management and Human Resources Planning*, McGraw-Hill, 1981.

4. Naval Facilities Engineering Command P-441.1, *Fiscal Year 1986 Operating Plan*, 30 October 1985.

5. Strasser, D. and Pearo, J., "Review of the Process for Determination of NAVFAC Program Workload and Resource Requirements at Western Division, Naval Facilities Engineering Command," unpublished report, Public Works Center San Francisco Bay, July 1986.

6. Nash, D. J., *A Comparative Study of Acquisition Departments in Two Engineering Field Divisions of the Naval Facilities Engineering Command*, Masters Thesis, Naval Postgraduate School, Monterey, California, December 1976.

7. Naval Facilities Engineering Command P-68, *Contracting Manual*, February 1985.

8. Naval Facilities Engineering Command Instruction 5450.73C, *Mission and Organization of Engineering Field Divisions*, 26 October 1982.

9. Western Division, Naval Facilities Engineering Command Instruction 5450.1B, *Organization and Functions Manual*, 5 August 1983.

10. *Practical Comptrollership*, Naval Postgraduate School, Monterey, California, 1985.

11. Wynn, A. L., CDR, U. S. Navy, *Facilities Programming*, paper presented at the NAVFAC 09A Conference, Kings Bay, Georgia, 30 April 1986.

12. Chief of Naval Operations Instruction 1000.16E, *Manual of Navy Total Force: Manpower Policy and Procedures*, 2 March 1981.

13. Naval School, Civil Engineer Corps Officers, *Public Works Manual*, March 1985.

14. Naval Engineering Facilities Engineering Command Instruction 5220.11G, *Goal Progress Reporting System*, 4 March 1985.

15. Ridgway, W. F., "Dysfunctional Consequences of Performance Measurement," *Administrative Sciences Quarterly*, v. 1, no. 10, pp. 240-247, September 1956.

16. Coleman, B. P., "An Integrated System for Manpower Planning," *Business Horizons*, pp. 89-95, October 1970.

17. Walker, J. W., "Forecasting Manpower Needs," *Harvard Business Review*, pp. 152-162, March-April 1969.

18. McMaster J. B., "Analyzing Workload and Staffing Requirements," *Supervision*, v. 40, no. 10, pp. 14-15, October 1978.

19. Navy Manpower Engineering Center, *Manual of Navy Manpower Engineering Program*, v. 2, August 1986.

20. Department of the Air Force, *Air Force Management Engineering Program*, AFR 25-5, v. 1, April 1982.

21. Department of the Air Force, *Air Force Management Engineering Program*, AFR 25-5, v. 2, April 1982.

22. Parker, G. A., *An Evaluation of the U. S. Navy's Facilities Acquisition Process*, Masters Thesis, Massachusetts Institute of Technology, Boston, Massachusetts, December 1976.

23. Galgano, M. P., "Distribution of Program IV Construction Related Costs to the Benefiting Programs Using Effort Related Workload Parameters of Contract Days, Contract Action, and Number of Projects," unpublished report, Naval Facilities Engineering Command, Alexandria, Virginia, 21 September 1979.

24. Telephone interviews with Mr. Mike Galgano, Naval Facilities Engineering Command, Alexandria, Virginia, 16-28 November 1986.

25. Telephone interview with Mr. Richard Durant, Headquarters Army Corps of Engineers, 25 November 1986.

26. Navy Manpower and Material Analysis Center, Work Center Staffing Standard Report, *Shore Facilities Acquisition Mission Area*, March 1984.

27. Cowden, J. M., Botsford, G., and Revay, J., "Organization and Staffing of NAVFACENGCOM Contracting Offices," unpublished report, Naval Facilities Engineering Command, Alexandria, Virginia, March 1984.

28. Telephone interview with Ms. Beth Dye, Northern Division, Naval Facilities Engineering Command, Code 09A1D, 19 November 1986.

INITIAL DISTRIBUTION LIST

		No. Copies
1.	Defense Technical Information Center Cameron Station Alexandria, Virginia 22304-6145	2
2.	Library, Code 0142 Naval Postgraduate School Monterey, California 93943-5002	2
3.	Mr. Gary Newton Western Division, Naval Facilities Engineering Command P. O. Box 727 San Bruno, California 94066	1
4.	CDR R. Hocker Naval Facilities Engineering Command 200 Stovall Street Alexandria, Virginia 22332-2300	1
5.	Dr. R. A. Weitzman Code 54 WZ Naval Postgraduate School Monterey, California 93943	1
6.	Kaiman Lee SMC #1146 Naval Postgraduate School Monterey, California 93943	1
7.	LT Ken Rado WESTDIV Contracts Office Box 209 Oceanside, California 92054	2
8.	Mr. Richard Durant HQUSACE DAEN-ECC-D (MANTAF) 20 Massachusetts Avenue NW Washington, D. C. 20314-1000	1

18356[illegible]

DUDLEY KNOX LIBRARY
NAVAL POSTGRADUATE SCHOOL
MONTEREY, CALIFORNIA 93943-5002

Thesis
R1375
c.1

Rado
An evaluation of the manpower staffing system for the Naval Facilities Engineering Command's facilities acquisition mission.

thesR1375
An evaluation of the manpower staffing s
3 2768 000 72796 0
DUDLEY KNOX LIBRARY